

University of Groningen

Did the Mamluks Have an Environmental Sense? Natural Resource Management in Syrian Villages

Walker, Bethany ; Laparidou, Sophia; Hansen, Annette; Corbino, Chiara

Published in:
Mamluk Studies Review

DOI:
[10.6082/M1H1304R](https://doi.org/10.6082/M1H1304R)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Walker, B., Laparidou, S., Hansen, A., & Corbino, C. (2017). Did the Mamluks Have an Environmental Sense? Natural Resource Management in Syrian Villages. *Mamluk Studies Review*, XX, 167-245.
<https://doi.org/10.6082/M1H1304R>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

BETHANY WALKER

UNIVERSITY OF BONN

ANNETTE HANSEN

UNIVERSITY OF GRONINGEN

SOFIA LAPARIDOU

UNIVERSITY OF THESSALONIKI

CHIARA CORBINO

UNIVERSITY OF SHEFFIELD

Did the Mamluks Have an Environmental Sense?: Natural Resource Management in Syrian Villages

The economic changes of Sultan Barqūq's reign and the post-Barqūqī era have increasingly come under scrutiny in recent years, changing the way we understand the transition to the Circassian Mamluk Sultanate.¹ The erosion of the *iqṭā'* system, through the transformation of state lands to private property, and the "wave of *waqf*" that emptied the Bayt al-Māl by Barqūq's reign (and then again at the end of the Mamluk Sultanate), necessitating a reorganization of the state fiscal administration and the creation of new financial bureaus, are topics that have generated a respectable body of scholarship.² In the background of these trends is the ever-changing status of land tenure and land use.

The co-authors of this article gratefully acknowledge the long-term support of the Jordanian Department of Antiquities and the American Center of Oriental Research in Amman during our many years of fieldwork in Jordan. Through a Harris Grant from the American Schools of Oriental Research we were able to conduct in 2014 the laser survey and 3-D documentation of subterranean water systems in support of our study of medieval-era irrigation. We also thank the Annemarie Schimmel Kolleg and our collaborative institutions in the United States, Andrews University and Missouri State University, who have partnered with us in the 2013, 2014, and 2016 excavations seasons at Tall Ḥisbān. To the Departments of Biology and Chemistry at the University of Bonn and Museum König in Bonn we also extend our sincere thanks for use of laboratory equipment and access to reference collections, which has made the scientific component of this study possible. On a final note, the "clean" version of this article would not have been possible without the careful reading, useful suggestions, and sound advice of our anonymous reader.

¹For analysis of the political changes of this transformative period, see Jo Van Steenberg, *Order out of Chaos: Patronage, Conflict and Mamluk Socio-Political Culture, 1341–1382* (Leiden, 2006); Koby Yosef, "Ethnic Groups, Social Relationships and Dynasty in the Mamluk Sultanate (1250–1517)," *ASK Working Paper 6* (<https://www.mamluk.uni-bonn.de/publications/working-paper/ask-wp-6.pdf>); and idem, "Mamluks and Their Relatives in the Period of the Mamluk Sultanate (1250–1517)," *Mamlūk Studies Review* 16 (2012): 55–69.

²Carl Petry, *Protectors or Praetorians? The Last Mamluk Sultans and Egypt's Waning as a Great Power* (Albany, 1994); idem, "Fractionalized Estates in a Centralized Regime: The Holdings of al-Ashraf Qaytbay and Qansuh al-Ghawri According to their Waqf Deeds," *Journal of the Social and Economic History of the Orient* 41, no. 1 (1998): 96–117; idem, "Waqf as an Instrument of Investment in the Mamluk Sultanate: Security or Profit?" in *Slave Elites in the Middle East and Africa: A Comparative Study*, ed. Miuru Toru and J. E. Philips (New York, 2000), 95–115; 'I. B. Abū Ghāzī, *Ṭaṭawwur al-Ḥiyāzah al-Zirā'iyah fī Miṣr al-Mamālik al-Jarākisah* (Cairo, 1988); Adam Sabra, "The Rise of a New Class? Land Tenure in Fifteenth-Century Egypt: A Review Article" *Mamlūk Studies Review* 8, no. 2 (2004): 207–10; Bethany J. Walker, *Jordan in the Late Middle Ages: Transformation*



©2017 by Bethany Walker, Sophia Laparidou, Annette Hansen, and Chiara Corbino. This work is made available under a Creative Commons Attribution 4.0 International license (CC-BY). Article DOI: [10.6082/M1H1304R](https://doi.org/10.6082/M1H1304R). (<http://hdl.handle.net/11417/736>)

DOI of Vol. XX: [10.6082/M1J10184](https://doi.org/10.6082/M1J10184). See <http://hdl.handle.net/11417/727> to download the full volume or individual articles. See <http://mamluk.uchicago.edu/msr.html> for more information about copyright and open access.

One cannot separate land tenure from land use, as they belong to the same economic system, so the study of agrarian culture, and—to rephrase it in modern parlance—natural resource management, is a natural outgrowth of this growing scholarship on the “waqfization of the countryside.” Yet, we have much to learn about how the widespread changes in land tenure of the post-Barqūqī era translated into sowing strategies, such as diversification of cropping, intensification of cultivation, shifts in hydrological practice, and diversification of animal husbandry. Agricultural history, in its widest sense, is relatively underdeveloped in our field.³

Mamluk scholarship has tended to focus in this regard on tax administration, and specifically on its application in the flood-basin irrigation regimes of Egypt (and namely the Fayyum), as the written record is most amenable to such research.⁴ We know precious little, however, about agricultural practice in Syria, where grain cultivation, at least, was largely rain-fed and constantly susceptible to drought. Bilād al-Shām and Egypt are—culturally, environmentally, geographically—very different worlds. The Syrian landscape is topographically and ecologically fractured, creating distinctly different soils and ecological niches. This geographical regionalism is reflected in Syria’s agricultural diversity and the many localized responses to environmental stress.⁵

of the Mamluk Frontier (Chicago, 2011); Daisuke Igarashi, *Land Tenure, Fiscal Policy, and Imperial Power in Medieval Syro-Egypt* (Chicago, 2015).

³ This scenario is, fortunately, changing. See the following recent works on Mamluk agriculture: Mathieu Eychenne, “La production agricole de Damas et de la Ghūṭa au XIV^e siècle: Diversité, taxation et prix des cultures maraîchères d’après al-Jazarī (m. 739/1338),” *Journal of the Economic and Social History of the Orient* 56 (2013): 569–630; Yehoshua Frenkel, “Agriculture, Land-tenure and Peasants in Palestine during the Mamluk Period,” in *Egypt and Syria in the Fatimid, Ayyubid and Mamluk Eras*, ed. Urbain Vermeulen and Jo Van Steenbergen (Leuven, 2001), 193–208; Sofia Laparidou and Arlene Rosen, “Intensification of production in Medieval Islamic Jordan and its ecological impact: Towns of the Anthropocene,” *The Holocene* 25, no. 10 (2015): 1685–97; and Noha Muḥammad Ḥussein Mukahalah, “Al-Zirā‘ah fī Bilād al-Shām fī al-‘Aṣr al-Mamlūkī” (M.A. thesis, Yarmouk University, 1992). On agriculture, food, and food distribution in Cairo, see Anthony Quickel, “Farm to Fork: Cairo’s Food Supply and Distribution During the Mamluk Sultanate (1250–1517)” (M.A. thesis, American University in Cairo, 2015).

⁴ On flood-basin agriculture in Egypt, see Stuart Borsch, “Nile Floods and the Irrigation System in Fifteenth Century Egypt,” *Mamlūk Studies Review* 4 (2000): 131–45; idem, “Environment and Population: The Collapse of Large Irrigation Systems Reconsidered,” *Comparative Studies in Society & History* 46, no. 3 (2004): 451–68; and Yossi Rapoport and Ido Shahrar, “Irrigation in medieval Islamic Fayyum: Local Control in a Large Scale Hydraulic System,” *Journal of the Economic and Social History of the Orient* 55 (2012): 1–31.

⁵ For environmental and anthropological perspectives on these regional differences, see Bethany J. Walker, “Homeland and Heimweh: Rural Perspectives on the ‘Syrian Experience,’” in *Between Saladin and Selim the Grim: Syria Under Ayyubid and Mamluk Rule*, ed. Reuven Amitai and Bethany J. Walker (Bonn, 2017), forthcoming.

Mamluk-era historians, in both Egypt and Syria, were well aware of the impact of environmental pressures, in their various forms, on their societies. Drought, for example, was a constant preoccupation of medieval Arab historians. The chroniclers demonstrate a real understanding of and concern for a wide range of climatic and environmental conditions (rainfall, temperature, land use and abuse), which they regularly cite as the direct cause of famines, revolts, and political decline. The annals of Damascene historians, in particular, are full of detailed references to rainfall, road conditions, prices of foodstuffs, and peasant and Bedouin riots, which they suggest were all interrelated.⁶ Many of these historians gained their income from managing rural endowments, and others maintained close contact with family in villages: they were sensitive to the relationship between man and his physical landscape and the potential of the natural elements in bringing economic suffering. That there was a relationship among the political, social, and natural orders was duly acknowledged by contemporaries. Al-Maqrīzī's *Ighāthah*, an Egyptian treatise on famine, is a veritable lament of the state's misuse of natural resources and mis-action in times of drought.⁷ Mamluk officials, as well, had a vested interest in the environment, natural resources, and particularly the viability of agricultural land and maintenance of water systems. There were clear agricultural interests, in certain sectors of that regime, and conflicts over natural resources were important flash points at times with local communities.⁸ Contemporaries were, in modern parlance, environmentally aware. To what degree officialdom actively imposed itself on agricultural practice, however, is not entirely clear.

This study is concerned with the agricultural policies, practices, and priorities of the Mamluk state in the fourteenth century, a period we are coming to associate with a "boom" in agricultural production and rural prosperity.⁹ It attempts, through a combined archaeo-historical method, to distinguish between imperial priorities and local practice, and to evaluate the "environmental sense" of Mamluk officialdom.¹⁰ This is a collaboratively written study that aims at an interdis-

⁶ The chronicles of Ibn Hījī and Ibn Ṭawq, discussed below, are particularly rich sources in this regard. They are the focus of several on-going monograph projects concerned with climate, agriculture, and diet in Mamluk Syria.

⁷ Taqī al-Dīn Aḥmad ibn 'Alī al-Maqrīzī, *Ighāthah al-ummah bi-kashf al-ghummah*, ed. Sa'd 'Abd al-Fattāḥ 'Āshūr (Cairo, 1990).

⁸ Boaz Shoshan, "Mini-Dramas by the Water: On Water Disputes in Fifteenth-Century Damascus," in *Histories of the Middle East*, ed. Eleni Margariti (Leiden, 2011), 233–44; Walker, *Jordan in the Late Middle Ages*, 207ff.

⁹ Bethany J. Walker, "Mamluk Investment in the Transjordan: A 'Boom and Bust' Economy," *Mamlūk Studies Review* 8, no. 2 (2004): 119–47.

¹⁰ The local perspective is beyond the scope of this article, but will be addressed in Walker's forthcoming "It Takes a Village: Local Know-How and Interdependencies in Syrian Agriculture,

ciplinary view of the policies and culture(s) of the Mamluk Sultanate in regards to agriculture and animal husbandry.¹¹ It collectively represents the methods and intertwined interpretations of a range of textual, archaeological, micro- and macro-botanical, and faunal data to reconstruct patterns of land use (and particularly crop choice), water use, diet, and agro-marketing as experienced in a single community in central Jordan.¹²

A field of research new to Mamluk Studies, archaeobotany, also known as palaeoethnobotany, is the study of human-plant relationships in the past. Phytolith analysis, which once began as a sub-field of archaeobotany but has developed into a field of its own, is the study of microscopic silica structures deposited in certain live plant tissues, such as the leaves, chaff (palea/lemma, also referred to as the “husk”), and straw. For our purposes, this method facilitates identifying grasses (Poaceae, the family that includes cereals) and evidence of irrigation of such crops down to the sub-family taxonomic level. It also allows identification of general families of plants that may or may not be detectable using other methods of analysis.¹³ Macro-botanical analysis is the study of seeds and fruits, including grasses that are associated with arable fields, cereal culm (or straw), chaff (palea/lemma), rachis internodes, glumes and other plant parts, and wood charcoal that can be identified to the genus, species, or sub-species levels. Based

the Late Medieval Era,” in *Environmental Approaches in Pre-Modern Middle Eastern Studies*, ed. Bethany J. Walker (Bonn, 2017).

¹¹ Collaborative writing, which should be distinguished from jointly authored writing, can take many forms. What the authors tried to avoid in this article is to write individual specialists’ reports, written without taking into consideration one another’s data, or to relegate technical studies to appendices, which is typical of many archaeological reports. The four authors worked from four different countries on a Google Drive base document (an archaeo-historical narrative that was subsequently revised multiple times), and consulted by email and Skype meetings, as well as visiting one another’s laboratories for consultation on data interpretation.

¹² While the analysis of seeds and animal bones has been part of the research design of excavations at the site since its inception four decades ago, the last three seasons are the first time the archaeological, historical, archaeobotanical, and zooarchaeological methods have been integrated in a manner to address specific questions about Islamic society. For the earlier archaeobotanical and zooarchaeological reports, see Øystein S. LaBianca, *Sedentarization and Nomadization: Food System Cycles at Hesban and Vicinity in Transjordan* (Berrien Springs, 1980); Øystein S. LaBianca and Larry Lacelle, *Hesban 02: Environmental Foundations: Studies of Climatical, Geological, Hydrological, and Phytological Conditions in Hesban and Vicinity* (Berrien Springs, 1986); and Øystein S. LaBianca and Angela von den Driesch, *Hesban 13: Faunal Remains: Taphonomical and Zooarchaeological Studies of the Animal Remains from Tell Hesban and Vicinity* (Berrien Springs, 1995).

¹³ Phytolith analysis is also an integral part of our larger study of long-term climatic and environmental change, in conjunction with palynology (pollen analysis). The relationship between long-term environmental change and settlement shifts on the Madaba Plains is one objective of the Madaba Plains Project, of which the Tall Hisbān excavations are a component.

on the identification of rachis internodes, furthermore, cereals can be identified down to the sub-species taxonomic level. Beyond this, charred dung may be identified in macro-botanical samples that can help point to the use of animal dung as fuel in cooking contexts.¹⁴ Together the study of phytoliths and macrobotanical remains can help us reconstruct crop selection and crop processing, the use of cereal by-products, watering regimes, manuring, and diet on both site and regional levels. Zooarchaeology is the study of animal remains from archaeological sites and aims at understanding past human-animal interactions. It provides essential information on diet, social status, animal husbandry, economy, and landscape exploitation.

None of this evidence, “read” independently from one another or interpreted without consideration of their spatial (archaeological) context, can offer us an authoritative picture about agrarian culture. On their own, each source of data is open to multiple interpretations. In dialogue with one another, however, archaeobotanical, zooarchaeological, and stratigraphic methods (the spatial documentation used by archaeologists) can offer nuanced narratives about land use. The textual record provides the political and economic backdrop for understanding the factors behind the patterns of resource exploitation that are revealed in this way in a single community, as well as contextualizing the decision-making process behind it.

The community that forms a case study for this article is a living one—the modern village of Ḥisbān—and the site of Tall Ḥisbān has been the focus of long-term excavation by American teams since 1968.¹⁵ The multi-period site of Tall Ḥisbān is located in the Madaba Plains of central Jordan (Fig. 1), which is today, as in the past, a highland plateau largely dedicated to grain cultivation (Fig. 2).¹⁶ It was one of the “bread baskets” of southern Syria in the Mamluk period, providing cereals in times of dearth both in Syria and Egypt and generating great income for the Mamluk state. This was the ancestral home of the Damascene historian

¹⁴ See A. M. Hansen, “The agricultural economy of Islamic Jordan, from the Arab conquest to the Ottoman period” (Ph.D. dissertation, University of Groningen, in preparation).

¹⁵ The Tall Hisban Cultural Heritage Project is part of the larger Madaba Plains Project, an American initiative begun nearly fifty years ago by Andrews University. The current project, which includes restoration, site presentation, and community development, is under the senior direction of Øystein LaBianca of Andrews University (Department of Anthropology). The excavations are under the direction of Bethany Walker. The study of diet and land use was included in the design of the excavations from their start in 1968, namely in the analysis of animal bones and plant seeds. For years the focus of excavations was the summit of the tell (the location of the citadel), with only intermittent excavations on the slopes (the location of the medieval village). Since 2013, excavations have been limited to the medieval village.

¹⁶ The agricultural landscape of the village today is a patchwork of grain fields alternating with olive groves.

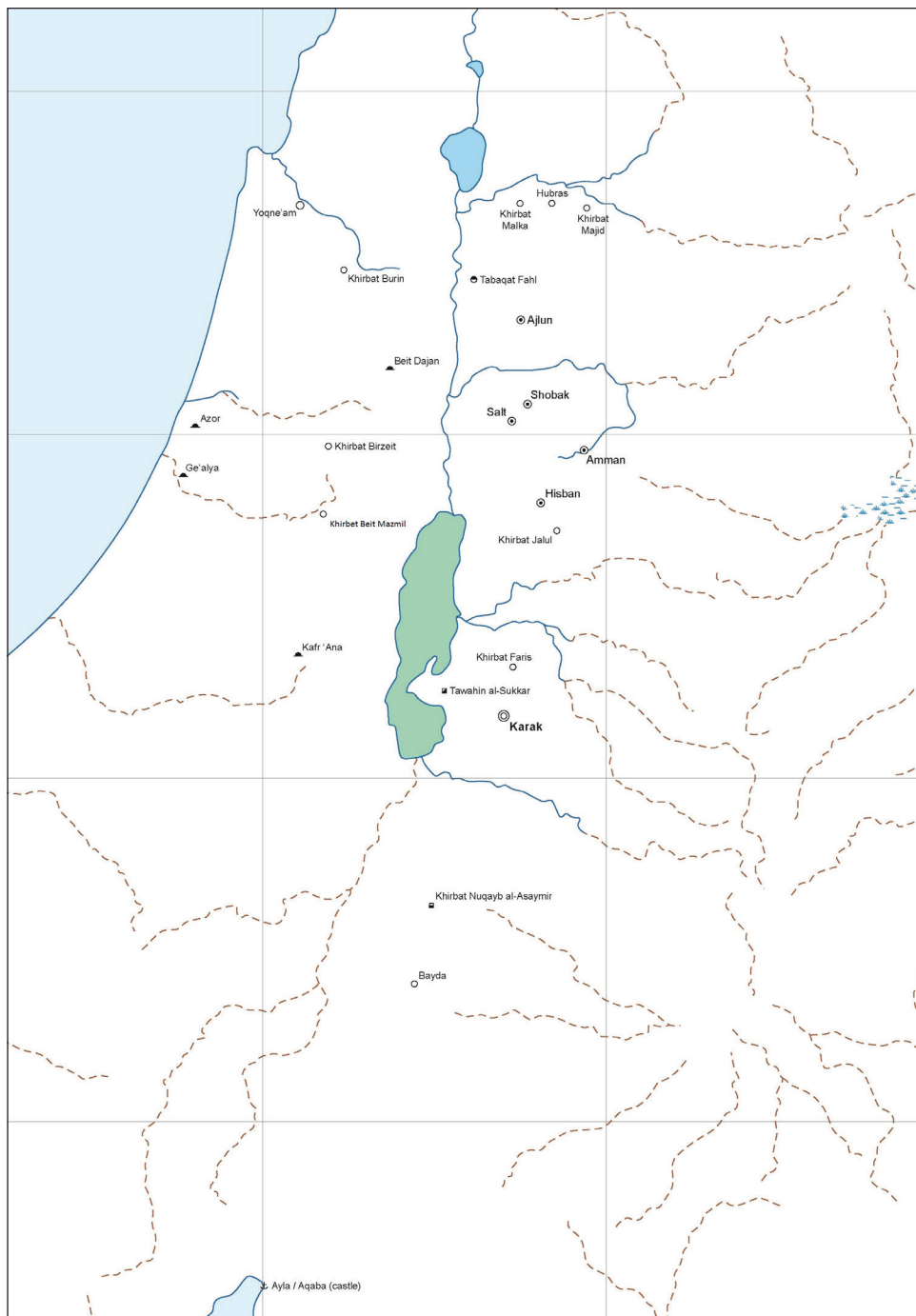


Figure 1. Mamluk-era sites in Bilād al-Shām known archaeologically. Tall Ḥisbān sits in the center. (Courtesy Martin Grosch, Beuth Hochschule für Technik, Berlin)



Figure 2. Modern village and tell of Ḥisbān surrounded by grain fields and olive orchards. (Courtesy Prof. David Sherwin, Andrews University, USA)

Ibn Ḥijjī (d. 816/1413), and the village retained familial and professional ties to Damascus for many generations. It is an important Mamluk-era site, and with its reasonably well-preserved citadel and the extensive standing remains of the farmhouses of the fourteenth-century village (Fig. 3),¹⁷ it provides a unique opportunity to study the relations between state and local society in a rural setting, and to potentially differentiate between imperial and local decision-making in relation to land, water, and animal management.

Mamluk Ḥisbān was the administrative capital of the Balqā District of central Jordan during the third reign of Sultan al-Nāṣir Muḥammad (709–41/1309–40), and housed a modest garrison at the top of the hill for several decades. The status of the settlement that supported the garrison vacillated between a village and a town over the course of the fourteenth century. At its height it commanded the markets of some 300 neighboring villages and housed a madrasah (built in the Ayyubid period), court (with its own qadī), and regional *sūq*. Its demise and gradual abandonment over the course of the fifteenth and sixteenth centuries may be tied to changes in the Mamluk state's land tenure policies and concomitant shifts

¹⁷ The eight-hectare site is defined by a fence, built by the Jordanian Department of Antiquities to protect it. The medieval site likely extended well beyond this fence, but the modern village sits on top of those potential remains. It consists of a small castle on top of a hill and a dense configuration of stone-built, single-room, barrel-vaulted farmhouses, most of which are organized in clusters that form a line of several houses and storerooms, all fronting a common, walled courtyard and shared cisterns. For detailed, technical reports on these farmhouses, which have only recently been the focus of excavations at the site, see Bethany J. Walker, "Planned Villages and Rural Resilience on the Mamluk Frontier: A Preliminary Report on the 2013 Excavation Season at Tall Hisban," in *History and Society during the Mamluk Period (1250–1517)*, Studies of the Annemarie Schimmel Research College I, ed. Stephan Conermann (Bonn, 2014), 157–92; and Bethany J. Walker, Robert D. Bates, Jeffrey P. Hudon, and Øystein S. LaBianca (with contributions by Tarina Greer, Aren LaBianca, Stuart Borsch, Warren Schultz, Chiara Corbino, Annette Hansen, and Sofia Laparidou), "Tall Ḥisbān 2013 and 2014 Excavation Seasons: Exploration of the Medieval Village and Long-Term Water Systems," *Annual of the Department of Antiquities of Jordan* 58 (2017): 483–523.



Figure 3. Aerial photo of Tall Ḥisbān. Square, walled citadel sits at center of photos. Wall lines of farmhouses visible around it downslope. (Courtesy APAAME_20090930_MJN-50 ©Michael John Neville, Aerial Photographic Archive for Archaeology in the Middle East)

in the agrarian regime. Large-scale cultivation of cereals, and the kinds of lands that supported it, were transformed to the greatest degree in this latter period.

While this study centers heavily on the cereal regime at Ḥisbān, the rural economy of most of Syria was a mixed one, combining the cultivation of different kinds of cereals, pulses, vegetables, fruits, and nuts in irrigated orchards; and raising animals for labor, meat, and dairy products. The focus on wheats(s) and barley, however, is conditioned by both the textual and archaeobotanical data. Grain fields were the most valuable of the agrarian *iqṭāʿāt* assigned to military and administrative officers; they were the financial underpinning of the medieval Islamic state. The history of cereal production, in short, is one lens through which to study the development of governance in the Mamluk Sultanate. The micro- and macro-botanical remains of wheat(s) and barley are also well preserved at Ḥisbān, permitting a finer grained study than is possible for other parts of the rural, agrarian economy.

The authors of this article have sustained interests in local, communal responses to water scarcity and variable soil conditions and the ways that officialdom has molded resource use. It is the result of their having worked decades in the fifth most water-starved country in the world: Jordan.¹⁸ It is a country where today the wheat harvest fails once out of every five years because of insufficient rainfall, and where management of natural resources is as much a political as a communal matter.¹⁹ This study reflects a long-term effort at integrated archaeological-textual-environmental research, which is the foundation of environmental archaeology. These efforts are now producing tangible results.

Concept-Building: What Do We Know, Historically, about Agriculture in Mamluk Syria?

To differentiate the agrarian policies of a regime from the traditional practices of local communities is not a simple matter, once we leave the realm of tax collection. The biggest challenge, of course, is to differentiate between the imperatives of government officials and the initiatives and ingenuity of the *fallāḥīn* in grain cultivation. In this regard, we can learn much from the better documented nineteenth century. Grain production in Transjordan was part of a market economy,

¹⁸ Jordan's limited water resources are notorious: its ranking as one of the most water-starved in the world is constantly adjusted by international agencies. "Water-starved" is defined as countries that run out of water for basic needs each year. It overlaps with, but it is not synonymous with the "drylands," those arid and semiarid lands in which the index of aridity is less than 0.65. See James Reynolds, "Desertification," *Encyclopedia of Biodiversity* 2 (2001): 61.

¹⁹ Carol Palmer, "Following the Plough: The Agricultural Environment of Northern Jordan," *Levant* 30 (1998): 132.



Figure 4. Nineteenth-century grain and flour storage facilities (shunahs) and flour mill, Wadi Ḥisbān: Shunats Saqr and Diyāb, photo of 1875. (Courtesy Palestine Exploration Fund [APES (American Palestine Exploration Society) 76/77 and PEF/P 1698/1699], London)

reaching a peak in the Tanzimat era (Fig. 4).²⁰ Local landowners controlled sowing, storage, processing (through flour mills), and marketing. Ethnographic studies in Greece, Cyprus, and Syria have highlighted the control that local peoples had, as well, over the cultivation of cereals from the sowing to harvest stages.²¹ State intervention occurred at the threshing floor, which became a symbol of the conflict between peasant communities and the state.²² It was here that taxes on cereals were collected in-kind, and guards hired by the government stood watch over the cereals still on the floor to make sure nothing was taken by the cultivators overnight.

Alan Mikhail's research has documented similar dynamics in Ottoman Egypt and current work by Wakako Kumakura promises to add much to our understanding of the agrarian culture in Egypt during the Mamluk-Ottoman transition.²³ The developing narrative is that the Ottoman state relied heavily on local

²⁰ Martha Mundy and Richard Saumarez Smith, *Governing Property, Making the Modern State: Law, Administration and Production in Ottoman Syria* (London, 2007); Lynda Schilcher, "The Grain Economy of Late Ottoman Syria and the Issue of Large-Scale Commercialization," in *Landholding and Commercial Agriculture in the Middle East*, ed. Ç. Keyder and F. Tabak (Albany, 1991), 173–95.

²¹ Palmer, "Following the Plow"; Michael Given, "Agriculture, Settlement and Landscape in Ottoman Cyprus," *Levant* 32 (2000): 209–30; Susan Sutton, *Contingent Countryside: Settlement, Economy, and Land Use in the Southern Argolid since 1700* (Stanford, 2000).

²² Michael Given, *The Archaeology of the Colonized* (Routledge, 2004).

²³ Alan Mikhail, *Nature and Empire in Ottoman Egypt: An Environmental History* (Cambridge, 2011). Wakako Kumakura, "The Early Ottoman Rural Government System and Its Development in Terms of Water Administration," in *The Mamluk-Ottoman Transition: Continuity and Change*

peasant know-how in flood-basin cultivation and left much of the pre-harvest decision-making on land use to them, intervening only in the cultivation of important cash crops, and only under extreme conditions of financial need and environmental disasters.

But can we say the same for the Mamluk period? Gladys Frantz-Murphy's and Sato Tsugitaka's classic studies of agriculture in Egypt describe a complex system of tax administration and documentation aimed at maximizing revenues and preventing fraud and oppression of peasants.²⁴ Based largely on al-Nuwayrī's *Nihāyat al-Arab* (which likely reflects practice in Syria), al-Maqrīzī's *Sulūk*, al-Qalqashandī, and Fatimid and Ayyubid-period sources on the Fayyūm (namely al-Makhzūmī, Ibn Mammātī, and al-Nābulusī), they argue convincingly for a largely autonomous agrarian economy. Cairo played little direct role in any rural land administration, delegating cadastral surveys, record-keeping, and tax collections to provincial and local officials. The most important in this regard was the *muqta'*'s estate manager (*wakīl*) and assistant (*mushidd/shādd*) who oversaw cultivation, collected taxes in kind, and maintained the irrigation canals; the director of the granaries (*mubāshir*); and the guard (*khafīr/hāris*), who kept watch over the uncollected cereals on the threshing floor and oversaw water distribution. The village shaykh and *khawli* (overseer) had the greatest knowledge of local practice and reported to provincial officers on the land cultivated and general agricultural conditions. Peasants had contact with these officials only, not with the central *dīwān*. Of these officials, it seems that only the village shaykh played any role in deciding what was sown, where and when, with the exception of sugar cane.²⁵ Cropping otherwise fell to local practice, which relied on traditional crop-rotation.

in *Egypt and Bilād al-Shām in the Sixteenth Century*, ed. Stephan Conermann and Gül Şen (Bonn, 2017), 95–122.

²⁴ Gladys Frantz-Murphy, *The Agrarian Administration of Egypt from the Arabs to the Ottomans* (Cairo, 1986); Sato Tsugitaka, *State and Rural Society in Medieval Islam: Sultans, Muqta's, and Fallow* (Leiden, 1997).

²⁵ This seemed to have been the practice all along in Egypt, and it certainly was in Syria, particularly in the Mamluk period. According to al-Nuwayrī, a range of village officials were responsible for tax assessments in early Mamluk times, and the only official of the central government involved in tax collection on the local level was the *mubāshir*, who worked directly with them (Sato, *State and Rural Society*, 70; Shihāb al-Dīn Aḥmad ibn 'Abd Allāh al-Wahhāb al-Nuwayrī, *Nihāyat al-Arab fī Funūn al-Adab*, ed. Dār al-Kutub al-Miṣriyah (Cairo, 1931), 8:245ff. This distancing of the central government from local administration is confirmed by other Mamluk-era sources (Sato, *State and Rural Society*, 105ff). In a memorandum (*tadhkirah*) to Amir Kitbughā (his Vice Sultan) on managing business in Egypt while he was away on campaign, Sultan Qalāwūn asserts the responsibilities of village shaykhs in this area (transmitted by Ibn Furāt and al-Qalqashandī, and published and translated by Sato, p. 114). Further study of al-Nuwayrī's narrative about the role of peasants and their community leaders in the administration of their own resources is forthcoming in Walker, "It Takes a Village."

These textual sources, however, give us no indication of kinds of cereals beyond “wheat” (*qamḥ/ḥinṭah*) and “barley” (*shaʿīr*) as broad categories. Wheat straw is mentioned, exceptionally, as a commodity in itself, shared among the *dīwān*, *muqṭaʿ*, and cultivators (*muzārīʿūn*), at least in the Ayyubid period (according to Ibn Mammāṭi). We learn, as well, that the *muqṭaʿ* paid 10% of his revenues for transport of cereals from the threshing floor to state granaries and to cover the customs duties levied at the river ports at Cairo (according to al-Maqrizī). Nonetheless, we do not know where sowing seed was stored or how it was distributed, how the transport of cereals to granaries and storage was organized, or any other details on the local logistics of the grain “business.”

Was the state’s involvement in its own agricultural sector limited to tax collection and distribution of those revenues? In other words, can we see the hand of the Mamluk government in agriculture beyond the mechanics of *iqṭāʿ* administration and taxation? Did the “state” (for want of a better term) play any meaningful role in managing its own natural resources; did it have a viable agrarian policy?

If we turn to contemporary almanacs and documentary sources, as well as Syrian chronicles and agrarian manuals, which record many local practices, a clearer picture of local realities emerges. It is beyond the scope of this article to go into detail about the contents of these sources, but we can make here quick reference to the kind of information we can glean from them. Coptic almanacs, for example, describe a wide range of cereals cultivated in Egypt at this time, going well beyond the general categories of “wheat” and “barley.”²⁶ Village flour mills, granaries (*shunāt*, often in the form of modified natural caves), and small, family-run bakeries are occasionally cited in the revenue-generating institutions that belong to rural endowments in southern Bilād al-Shām in the fragmentary Mamluk-period *waqfīyāt* that can be identified, every now and then, in the archives of Cairo and Damascus. Many of these institutions also appear in the tax registers of the early Ottoman period, which cite the general categories of “wheat” (*ḥinṭah*) and “barley” (*shaʿīr*) as taxable commodities.

Local narrative sources are particularly useful in this regard. Ottoman-period texts may be culled for potential information regarding local baking traditions that reveal patterns of grain production even in earlier periods. To cite one example, the eighteenth-century scholar Ibn Kannān devotes a section of his historical geography of Damascus and its hinterland, *Al-Mawākib al-Islāmīyah fī al-Mamālik wa-al-Maḥāsin al-Shāmīyah*, to the topic of village bread. He classifies breads (all of which have their own name) on the basis of whether they were made primarily of wheat or barley flour (or a mixture of the two), and in what kind of oven they were baked. He occasionally describes the quality of the flour (by color, texture)

²⁶ Charles Pellat, *Cinq calendriers Égyptiens*, Textes Arabes et Études Islamiques (Cairo, 1986). We thank our anonymous reviewer for this reference.

and provides full recipes for baking breads and pastries. Interesting in this regard is a kind of barley bread to which is added a small amount of wheat flour “for taste.”²⁷ The specific wheat to be used is specified as “the kind of wheat called ‘*al-sult*.’ It is, in fact, a type of barley that resembles wheat, as it has no husk, and is often considered a type of wheat, as a result.”²⁸

Agrarian manuals are an underutilized source on rural life. Unlike many medieval Arabic encyclopedias, the authors of *kutub al-filāḥah* were not mere compilers (at least in this period), but practitioners in the field, many with personal experience in farming and crop experimentation. While it is not clear for whom such manuals were written, it is plausible that one audience were gentleman farmers, the proprietors of new estates and gardens, as the texts make regular reference to the preparation and levelling of new fields, excavating new wells, and the reclamation of marginal lands.²⁹ The last flowering of this genre was in Mamluk Syria (and specifically Damascus), where at least three major manuals were composed in the fourteenth and fifteenth centuries.³⁰ These manuals were also written for sultans and were exchanged among heads of state: the Ottoman Sultan Bayezid II, for example, asked the Mamluk Sultan Qānṣūh al-Ghūrī for a copy of Rādī al-Dīn al-Ghāzī’s *Jāmi‘ farā’iḍ al-milāḥah fī jawāmi‘ fawā’iḍ al-filāḥah*

²⁷ Muḥammad ʿIṣā Ibn Kannān, *Al-Mawākib al-Islāmiyah fī al-Mamālik wa-al-Maḥāsin al-Shāmiyah*, ed. Ḥikmat Ismāʿīl (Damascus, 1992), 260. Contemporaries appear to have been divided on the culinary value of barley flour. Ibn Ṭūlūn transmits the complaints of one Damascene scholar who was served “only barley bread and some leben” for breakfast during Ramadan at one city mosque (Muḥammad Ibn Ṭūlūn, *Al-Qalāʾid al-Jawharīyah fī Tārīkh al-Sālihiyah*, ed. Muḥammad Aḥmad Duḥmān (Damascus, 1949–56), 2:553. Clearly not everyone liked the taste of barley!

²⁸ *وَالسُّلْتُ، بِالضَّمِّ: ضَرْبٌ مِنَ الشَّعِيرِ؛ وَقِيلَ: هُوَ الشَّعِيرُ بَعِينُهُ؛ وَقِيلَ: هُوَ الشَّعِيرُ الْحَامِضُ؛ وَقَالَ اللَّيْثُ: السُّلْتُ شَعِيرٌ لَا قَشْرَ لَهُ أَجْرَدُ؛ زَادَ الْجَوْهَرِيُّ: كَأَنَّهُ الْحِنْطَةُ؛ يَكُونُ بِالْغَوْرِ وَالْحِجَازِ، يَنْبَرِّدُونَ بِسَوِيقِهِ فِي الصَّبْفِ. وَفِي الْحَدِيثِ: أَنَّهُ سئلَ عَنْ بَيْعِ الْبَيْضَاءِ بِالسُّلْتِ، هُوَ ضَرْبٌ مِنَ الشَّعِيرِ أَبْيَضٌ لَا قَشْرَ لَهُ؛ وَقِيلَ: هُوَ نَوْعٌ مِنَ الْحِنْطَةِ؛ وَالْأَوَّلُ أَصَحُّ، لِأَنَّ الْبَيْضَاءَ الْحِنْطَ.* (Muḥammad ibn Mukarram Ibn Manẓūr [1232–1311], *Lisān al-ʿArab*). Reference courtesy of Daniel Varisco.

²⁹ The development of these manuals from encyclopedias (for scholars) to practical manuals (for practitioners) must be understood as the shifting interests of the ulama themselves, who came to manage (and own) farmland with the expansion of rural endowments in the fifteenth and sixteenth centuries. Ibn Ṭawq and al-Ghāzī were such scholar-gentleman farmers.

³⁰ They are *Miftāḥ al-Rāḥah* (author unknown, but probably Syrian), *Mināḥij al-Fikr wa-Manāḥij al-ʿIbr* (by Ibn Yaḥyā [d. 1318], known as “al-Waṭwāt al-Warrāq”), and *Kitāb al-Durr al-Multaḥaṭ fī Akhbār Filāḥatī al-Rūm wa-al-Nabaṭ* (by al-Dimashqī [d. 1326], also known as “Shaykh al-Rabwa”). For more information on these manuals and the genre in general, see A. H. Fitzwilliam-Hall, “An Introductory Survey of the Arabic Books of Filāḥa and Farming Almanacs,” 2010 online publication of The Filāḥa Texts Project: The Arabic Books of Husbandry. Accessed on 10 January 2017, <http://www.filaha.org/introduction.html>.

for his personal library.³¹ The sudden revival of interest in Syria in this kind of knowledge in the fourteenth and fifteenth centuries may be related to the widespread endowment and privatization of agricultural lands at the time. These manuals remain largely in manuscript form and are only now coming under serious scholarly study. They have untapped potential for documenting the realities of local agricultural practice.³²

Many of the manuals of this period pull from earlier texts, in an encyclopedic fashion, and focus on water and soil conditions, what crops are best suited to sowing under these conditions, and preparation of soils.³³ *Miftāḥ al-Rāḥah*, written in the fourteenth century by a Syrian whose identity has not yet been confirmed, is one example. In a passage that pulls from Ibn Waḥshīyah's *Filāḥah al-Nabaṭīyah*, the anonymous author of this compilation describes "best practices" in wheat cultivation, that require soaking the sowing seeds in advance in water, sowing and harvesting as early as possible, and sowing in deep soil, in order to produce "fat" cereals.³⁴ Though based on an earlier Egyptian text, it nonetheless transmits the kind of traditional knowledge still valued by peasants of the day. By contrast, other contemporary manuals are based on peasant know-how of the day (the compilers acknowledging as much in their introductions). They may have functioned more as "how-to" books than mere compilations of knowledge.³⁵

³¹ Aleksandar Sopov, "The Transformation of Agricultural Knowledge and Urban Space in Ottoman Istanbul and Mamluk Cairo at the Turn of the Fifteenth Century" (Paper presented at the international conference "The Long 15th Century: Deep Transformations and New Possibilities," American University of Cairo, 20–21 March 2015); idem, "Between the Pen and the Fields: Books on Farming, Changing Land Regimes, and Urban Agriculture in the Ottoman Eastern Mediterranean ca. 1500–1700" (Ph.D. diss., Harvard University, 2016).

³² *Mināḥij al-Fikr* and *Jāmi' farā'id* are, apparently, based on contemporary peasant practice. In the case of the latter work, the author (al-Ghāzī, d. 1558), himself a farmer, interviewed local peasants to ask them about local practices. The section on plants in Ibn Yaḥyā's *Mināḥij al-Fikr* pulls on village knowledge of the day (al-Mukahalah, "Al-Zirā'ah fī Bilād al-Shām," 5–6).

³³ One notable exception—*Jāmi' farā'id*—is discussed later in this article.

³⁴ Anonymous, *Miftāḥ al-Rāḥah li-Ahl al-Filāḥah*, ed. Muḥammad 'Isā Ṣāliḥīyah and Iḥsān Ṣidqī al-'Amad (Kuwait, 1984), 125.

³⁵ At some point the function of the agrarian manuals changed from encyclopedias (for scholars) to practical manuals (for practitioners), mixing local knowledge with earlier texts. This development is recognizable in the fourteenth–sixteenth-century Syrian texts and may be related to the increasing privatization and endowment of land of the period, privileging, in particular, members of the ulama who came to manage these estates and financially benefit from them. Among the compilers of these manuals such scholars who owned (or managed) land and were actively developing fields and gardens (such as al-Ghāzī). This was true, as well, in Rasulid Yemen. The thirteenth-century Yemeni sultan al-Mālik al-Ashraf wrote in his agricultural text that he collected knowledge from farmers (personal communication, Daniel Varisco).

As such they offer great potential in describing for us local knowledge about soils, water, and plants.

Syrian chronicles provide a different level of information about local traditions in grain cultivation. One of the richest is that of Ibn Ḥijjī.³⁶ The historian Ibn Ḥijjī “al-Ḥisbānī” (d. 816/1413) was born in Damascus in 751/1350. His father, Ḥijjī ibn Mūsá, was born in the village of Ḥisbān in today’s central Jordan, where he served as a qadi.³⁷ His chronicle is full of references to letters he exchanged with family and colleagues in Ḥisbān and other Transjordanian villages and his many trips to his family home. His brief, but all too frequent, references to village agriculture reflect a preoccupation with village affairs that goes beyond an urban concern for endowment revenues. Among the information he provides on the local grain cultivation are references to confiscations (and forced sales) of village and urban barley stores during military campaigns,³⁸ peasant transport of cereals from the threshing floor to storage facilities,³⁹ local clerics with great knowledge of agriculture (and who are considered sources of authority on grain cultivation),⁴⁰ and the transport of cereals by camel and storage in repurposed cisterns.⁴¹ He also describes the business of grain cultivation: the career of a *mubāshir* who worked his way up from low employee of a mill (sifting flour) to a crop broker (*simsār fī al-ghallah*) and who became wealthy by hoarding grain,⁴² the price of “clean” wheat (the most expensive grain, paid in silver per sack),⁴³ and the price of cereals purchased at the threshing floor (wheat was half the price than in town, and barley 1/3).⁴⁴ The latter point likely refers to brokerage of cereals. The wealthiest

³⁶ Shihāb al-Dīn Abū al-‘Abbās Aḥmad al-Sa‘īdī al-Ḥaṣbānī al-Dimashqī Ibn Ḥijjī, *Tārīkh Ibn Ḥijjī*, ed. Abū Yaḥyá ‘Abd Allāh al-Kanadārī (Beirut, 2003).

³⁷ Ibn Ḥajar al-Asqalānī, *Inbā’ al-Ghumr bi-Anbā’ al-Umr*, ed. Muḥammad Aḥmad Duhmān (Damascus, 1979), 2:223; 3:18. For an analytical biography of the historian, see Sami G. Massoud, *An Analysis of the Annalistic Sources of the Early Mamluk Circassian Period* (Leiden, 2007), 180ff.

³⁸ Ibn Ḥijjī, *Tārīkh*, 1:173.

³⁹ Ibid., 1:330.

⁴⁰ Ibid., 2:693. This is a particularly interesting, and lengthy, entry, as it describes in some detail a rural cleric, who would not normally have appeared in a chronicle. The biographical entry is of an ‘alīm from a village in the Hawran, who settled in Adhri‘āt (modern Dera‘a, on the Jordanian-Syrian border) and farmed there the rest of his life. He served as qadi in that village, and his son became qadi of the villages of Irbid and Ḥubrās, continuing in that office to the time of Ibn Ḥijjī’s writing. See also *ibid.*, 2:343, for another biography of a judge to whom peasants turned for advice on farming.

⁴¹ Ibid., 2:642.

⁴² Ibid., 1:221–22.

⁴³ Ibid., 2:670.

⁴⁴ Ibid., 1:420.

ulama, on passing away, are said to have left behind hundreds of bags of wheat in their stores.⁴⁵

Shihāb al-Dīn Aḥmad ibn Muḥammad Ibn Ṭawq was a Damascene notary, who maintained close friendship ties with people from the village of Ḥisbān. His *Al-Ṭaʿlīq* stands at the border of chronicle and diary and has attracted considerable interest by Mamluk scholars in recent years. Ibn Ṭawq travelled frequently between Damascus, its suburbs, and more distant villages, mostly on business: he was involved in real estate, commercial agriculture, and small-scale brokerage.⁴⁶ He often travelled with peasants and seems to have even worked with them in the fields occasionally. Relevant to this discussion are his brief descriptions of village grain cultivation. By the time of his writing (early sixteenth century) the ulama came to own many small plots of land in scattered villages, mostly as the recipients of endowment revenues. They regularly inspected these fields, and met frequently with peasants and village leaders in getting information about land conditions and harvests. This land included orchards but also modest-sized grain plots—a relatively new development in the topography of grain cultivation in the region and one that is also reflected in the early Ottoman tax registers. He speaks, as well, of the “*sultī*” wheat mentioned in Ibn Kannān’s geography of the same city two hundred years later.⁴⁷ By the end of the Mamluk Sultanate, the ulama had come to be mediators, for better or worse, between villagers and the government, and as they did, indigenous knowledge of agriculture became more important than ever.

Integrated Methods from Five Disciplines

What we get from the textual sources is some sense of local knowledge and land use traditions, but primarily state priorities in the agricultural sector and the structure of its administration. What we miss in them is the peasant (or “cultivator’s”) perspective, evidence of local initiative in land use, and the decision-making process (why people sowed what did they and how they did). The archaeological record has much to offer in this regard, as it bears physical witness to cropping practices in meaningful spatial contexts. It is difficult, though, to make any statements about state policies in natural resource management based on the organic remains from excavations in themselves: they do not convey whether the farmer grew a particular crop, for example, out of his own free will (because they

⁴⁵ Ibid., 1:253.

⁴⁶ Torsten Wollina, “What is a City? Perceptions of Architectural and Social Order in 15th-Century Damascus,” in *History and Society during the Mamluk Period*, ed. Conermann, 221.

⁴⁷ Shihāb al-Dīn Aḥmad ibn Muḥammad Ibn Ṭawq, *Al-Ṭaʿlīq: Yawmīyāt Shihāb al-Dīn Aḥmad Ibn Ṭawq, 834–915H/1430–1509M*, ed. Jaʿfar al-Muhājir (Damascus, 2000), 1:158.

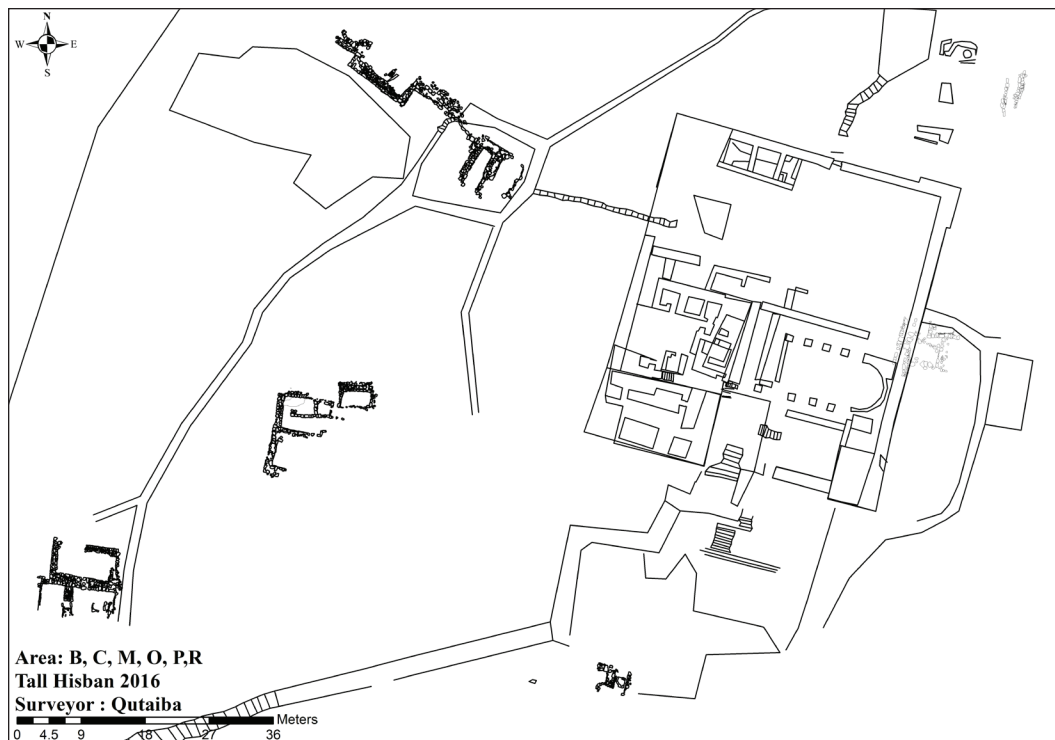


Figure 5. Floor plans of farmhouse clusters site-wide, Tall Ḥisbān. (Courtesy Qutaiba Daisuke, Municipality of Dubai, Department of Archaeology)

helped him achieve certain goals or operated within certain environmental restraints) or whether “the state” had made that decision for him. For that we need a critical reading of relevant textual sources, with which one could test interpretations of the archaeobotanical and faunal record. In other words, only by combining textual and archaeological data, we can begin to reconstruct the intersection of decision-making and practice and differentiate between the implementation of governmental policies and autonomous peasant action.

This multi-disciplinary investigation pulls from data collected during the excavation seasons of 2013, 2014, and 2016, which were concentrated in the farmhouses and courtyards of the medieval village. This data is compared to that of previous excavations in the Mamluk citadel (living quarters, storage facilities, and kitchens), with limited work in farmhouse remains (Fig. 5).⁴⁸ While the stratigraphy of most medieval Islamic rural sites tends to be poor, the Mamluk-period occupational levels at Tall Ḥisbān are comparatively good, with collapsed barrel roofs sealing deposits in the houses and citadel storeroom, and thick plastered floors providing stratigraphic separation of occupational sequences in the houses.

⁴⁸ The specific field seasons are 1998, 2001, 2004, and 2007.



Figure 6. Soil sampling for macrobotanical and phytolith remains at Tall Ḥisbān, occupational surface, Field P farmhouse (2016 excavation season). (Walker, project files)



Figure 7. Post-abandonment domestic use of citadel entrance at Tall Ḥisbān (2010 excavation season). Note stone-lined hearth and secondary wall delimiting stable. (Courtesy Tarina Greer, Missouri State University)



Figure 8. Citadel storerooms, with barrel vault collapse removed (2007 field season). (Walker, project files)

Moreover, not only is the architectural preservation here quite good, but so is that of the phytolith, archaeobotanical, and zooarchaeological remains, as attested by the soil samples collected from domestic and storage contexts. This rich data allows us to systematically pursue an intensive study of the agrarian and animal husbandry regimes at a single settlement.

The three environmental scientists who are co-authors of this article have sampled together and from the same contexts: the citadel storeroom and the floors and pits of the farmhouses and built spaces associated with them (such as *tābūn* houses, storage facilities, and stables). The sampling of soils was done at regular intervals across the floors of these built spaces, in order to prevent missing areas of activity that may have been devoted to grain processing (such as dehusking), storage for later use (laying aside of dung cakes for cooking, fodder for animals, fuel for the household, for example), and use (baking and cooking, slaughtering, animal bedding, use as construction material, etc.) (Fig. 6). The samples have been taken from the most important food processing, cooking, storage, and disposal (middens—trash pits) contexts in both the citadel (Fig. 7) and village farmhouses and include the citadel storeroom (Field L, Fig. 8), citadel midden (Square M1—a pit on the north slope just outside the northeast corner tower), a house on the north slope divided into two in a later phase of use and repurposed as a kitchen (Square M8, Fig. 9), the middens and floors of interior rooms and exterior courtyards of a cluster of farmhouses to the southwest of the tell (Field O, Fig. 10), the middens



Figure 9. Middens in Square M8 on the northern slope of the tell. Note the layers of red and gray in section, the possible result of repeated firing or cooking. (Walker, project files)



Figure 10. Field O farmhouse with plastered floors (2014 excavation season). (Walker, project files)



Figure 11. Field P farmhouse with walled, exterior courtyard (2016 excavation season). (Courtesy Nicolò Pini, University of Köln)

and floors of interior rooms and exterior courtyards of a stand-alone farmhouse to the extreme southwest of the tell (Field P, Fig. 11), and the kitchen of a farmhouse (Square C102, Figs. 12a and b) in a cluster of similar structures on the west slope of the tell (Field C). The strata (depositional layers) are securely dated to the fourteenth century, the period when the site was at its peak of occupation and prosperity.

Methods and Sampling

Phytoliths

Phytoliths (plant stones) are diagnostic of different plant families and economic crops. They are also diagnostic of different plant parts, thus they provide plant anatomical information. Plants produce single-cell and multi-cell phytoliths. Single-cells are individual cells silicified within the plant. Multi-cell phytoliths are conjoined single-cells that form “silica skeletons” of adjacent cells of the epidermal tissue of grasses.⁴⁹ Single-cell and multi-cell phytoliths have the potential to

⁴⁹ Arlene M. Rosen and Steve Weiner, “Identifying ancient irrigation: a new method using opaline phytoliths from emmer wheat,” *Journal of Archaeological Science* 21 (1994): 125–32.



Figure 12a. Field C Byzantine-era farmhouse reused in fourteenth century. Mamluk-era kitchen space walled off just inside arched doorway. (Walker, project files)



Figure 12b. Detail of cooking space in room corner (excavated in 2007, freshly sampled in 2016). Note alternating red, white, and black layers of soil and ash. (Walker, project files)

identify large-scale agriculture via irrigation,⁵⁰ agricultural activity areas⁵¹ such as crop processing areas, areas for animal husbandry practices, crop and fodder storage areas; and more.⁵²

In order to investigate medieval land use at both “state” and village level, the areas chosen for phytolith sampling and analysis were peasant households and the Mamluk citadel and garrison at Tall Ḥisbān. The phytolith record from the peasant village provides a direct line of evidence for studying the agro-pastoral practices at the village level during the period that the citadel housed the Mamluk garrison. The phytolith record from the citadel provides direct evidence for the control of the cereal production and management of grain cultivation under Mamluk rule.

Samples were collected from Area L, the fourteenth-century residence of the governor of al-Balqa, at the western part of the citadel. Samples were collected from a storeroom (Field L), dated to the same period, from Square Q5, which is an open-air courtyard used in a “squatter” period of occupation after the mid-century earthquake, and from Square Q2, a hearth/ashy deposit inside the storeroom (Field L). In addition, samples were collected from Field M1 that is located at the upper slopes of the tell below the northeast corner tower of the citadel and the fortification wall. This area was identified as a midden, or a refuse area of the residential complex inside the citadel. In addition, samples were collected from buildings located on the slopes of the tell where the medieval village was located

⁵⁰ Emma Jenkins, “Phytolith taphonomy: a comparison of dry ashing and acid extraction on the breakdown of conjoined phytoliths formed in *Triticum durum*,” *Journal of Archaeological Science* 36 (2009): 2402–7; Marco Madella, Martin K. Jones, Patrick Echlin, Alix Powers-Jones, and Michael Moore, “Plant water availability and analytical microscopy of phytoliths: implications for ancient irrigation in arid zones,” *Quaternary International* 193: 32–40; Rosen and Weiner, “Identifying ancient irrigation”; Alison Weisskopf, Emma Harvey, Eleanor Kingwell-Banham, Mukund Kajale, Rabi Mohanty, and Dorian Q. Fuller, “Archaeobotanical implications of phytolith assemblages from cultivated rice systems, wild rice stands and macro-regional patterns,” *Journal of Archaeological Science* 51 (2014): 43–53.

⁵¹ Phillipa Ryan, “Plants as material culture in the Near Eastern Neolithic: perspectives from the silica skeleton artifactual remains at Çatalhöyük,” *Journal of Anthropological Archaeology* 30 (2011): 292–305; Marta Portillo, Rosa M. Albert, and Donald O. Henry, “Domestic activities and spatial distribution in Ain Abū Nukhayla (Wadi Rum, Southern Jordan): The use of phytoliths and spherulites studies,” *Quaternary International* 193 (2009): 174–83; Sullivan and Lisa Kealhofer, “Identifying activity areas in archaeological soils from a colonial Virginia house lot using phytolith analysis and soil chemistry,” *Journal of Archaeological Science* 31 (2004): 1659–73.

⁵² Emma Harvey and Dorian Q. Fuller, “Investigating crop processing using phytolith analysis: the example of rice and millets,” *Journal of Archaeological Science* 32 (2005): 739–52; Dolores R. Piperno, *Phytoliths: a comprehensive guide for archaeologists and paleoecologists* (Lanham, MD, 2006); Jean Dominique Meunier and Fabrice Colin, *Phytoliths: Applications in earth science and human history* (Lisse, Netherlands, 2010).

and from one of the barrel-vaulted structures, namely M8, on the slopes of the tell where the medieval village was located. Several samples were taken across the floor of M8, which was a hard compact floor surface, retaining plaster in certain areas, and from a midden in the room. In addition, samples were collected from two Mamluk-era farmhouses at the southwestern slopes of the tell (Field O), from across the floors, a storage bin, hearths, and a midden excavated in one of the farmsteads.

Sediment samples were processed at the Institute of Archaeology, University College London, and at the Environmental Archaeology Lab, at the Anthropology Department at the University of Texas at Austin, using a protocol as adapted from Rosen.⁵³ A well-established plant phytolith reference collection regionally specific to the Near East was available for the purposes of plant and crop identification. Eight mg of archaeological sediment was sieved using a 0.5mm sieve and a 10% HCl solution to remove pedogenic carbonates. Any remains of HCl were removed using a centrifuge at 2000rpm for five minutes. Clays were removed by settling using a Calgon solution (sodium hexametaphosphate) to disperse the clay. Air dried samples were then burned in a 500 degree furnace for 2 hours in order to remove organic matter. Finally, 3ml Sodium polytungstate solution was added to the samples and they were centrifuged in order to extract the phytolith content. Phytolith remains were then left to dry and 2mg of phytoliths per sample were mounted on microscope slides using Entellan (Merck) mounting solution.

Slides were scanned and phytoliths were counted using a light transmitting microscope at x 400 magnification. For statistically significant results, a minimum of 200 single-cell and 100 multi-cell phytoliths were identified and counted. Absolute counts of phytoliths per gram of sediment are used in order to make comparisons possible between samples acquired from across contexts and were used for graphic representation of phytolith densities. Phytolith results are presented in bar charts that display absolute counts of phytoliths per gram of sediment. Bar charts illustrate the distribution of certain phytolith forms within various archaeological contexts.

Macrobotanical Remains

The archaeobotanical investigation at Tall Ḥisbān aims to elucidate changes in agricultural practices from the Byzantine-Islamic transition through the early Ottoman period, the Mamluk period being of particular interest.⁵⁴ Both archaeobotany and phytolith analysis ultimately focus on plant-derived materials and

⁵³ Arlene M. Rosen, "Phytolith indicators of plant and land use at Çatalhöyük," in *Inhabiting Çatalhöyük, Reports from the 1995–99 Seasons*, ed. Ian Hodder (Cambridge, 2005), 203–12."

⁵⁴ Hansen, "The agricultural economy of Islamic Jordan."

crop-husbandry activities at an archaeological site. Archaeobotany, however, focuses on organic plant materials, most notably seeds and fruits, whereas phytolith analysis studies non-organic materials.⁵⁵ Archaeobotany, or the study of macro-botanical remains, can assess many key features in the agricultural economy of a site: it can identify economic crops and determine their relative importance, identify crop-processing activities and methods, and identify crop processing by-products and determine their function within different industries such as ceramic production. It can also identify weed species that reflect both signals from the arable fields and the local environment. Furthermore, the study of the proportion of different macro-botanical materials, cereals, cereal by-products, wild species, and wood charcoal can be investigated within their respective archaeological contexts to assess their use or role in various economic activities: threshing, the use of dung and cereal by-products (straw, chaff, glume bases, and rachis internodes) as fuel, the use of cereal by-products as temper in ceramics or binder in dung, cooking and baking activities, building materials, and many more. Though archaeobotanical studies have a long tradition in the Near East and particularly in Bilād al-Shām,⁵⁶ the Islamic periods have received less attention; this study aims to help close this gap in knowledge and shed more light on agricultural practice in the Mamluk period.

In order to coordinate the sampling of macro-botanical and phytolith samples, a sampling protocol was established by Hansen and Laparidou in 2014. Soil samples for macro-botanical analysis were collected and their volume was measured prior to processing through flotation. Samples are poured into the flotation machine and the botanical remains, being less dense than water, float to the top of the flotation tank and are collected and dried in chiffon bags; heavy plant remains (alongside sand, rock, glass, pottery, and other materials) sink to a lower sieve (1.0 mm) where they are collected.⁵⁷ This material from the heavier fraction is dried, after which it is dry-sieved over 1.0 and 0.5 mm sieves. The plant remains from these two fractions are then combined and the volume is measured, after which each sample is sieved over 4.0mm, 2.0mm, 1.0mm, and 0.5mm sieves in order to separate larger and smaller fractions for efficient analysis. Archaeobotanical materials are then sorted, identified to the lowest possible taxonomic level (genus, species, or sub-species) and quantified (if applicable to the type of remains) using a light binocular microscopic with magnification up to 40x.

Macro-botanical remains were processed at the Laboratory of Palaeobotany and Palynology at the Groningen Institute of Archaeology (GIA) in the Nether-

⁵⁵ See Laparidou, phytoliths sections of this article.

⁵⁶ The pioneering work of Daniel Zohary, Maria Hopf, Ehud Weiss, and Avinoam Danin is of particular note.

⁵⁷ Deborah M. Pearsall, *Paleoethnobotany: A Handbook of Procedures* (London, 2015).

lands. This laboratory is home to one of the largest archaeobotanical reference collections in the world of over 36,000 accessions, including archaeological and modern specimens from numerous locations, including the Levant. In order to make precise identifications, the following atlases, including *Flora Palaestina*⁵⁸ and *The Digital Plant Atlas*,⁵⁹ are consulted, while modern or archaeological examples from the reference collection are checked for comparison.

The studied samples come from domestic contexts, including the inside of houses, outside courtyards, and nearby middens. Further contexts include beaten earth surfaces, plaster surfaces, pits, middens or domestic discard fills, jar fills, and cooking areas (hearths, areas associated with *tābūn* fragments). The macro-botanical remains were mostly preserved in charred (also known as carbonised) and mineralised conditions, with very few desiccated remains. The majority of samples were from stratigraphically secure contexts, with most of the pottery comprised of Mamluk-era HMGP (Handmade Geometric-Painted Ware) sherds, a locally produced pottery. A few control samples were taken to be able to record the “settlement noise” signal at the site, which reflected some of the main crops, such as barley and olive. Clay oven fragments from 20 contexts, likely from *tāwabīn*, were also analysed for their macro-botanical impressions and the different pathways, which produced those impressions.⁶⁰ Wood charcoal samples were taken and will be discussed in a separate study.⁶¹ Each of the Mamluk contexts from which samples were taken will be briefly discussed.

Field L

Much of the excavation of Field L1, the storeroom on the citadel, occurred prior to the 2013 excavation season, and the bulk of the surface (Loci 10 and 12) had been removed before macro-botanical samples could be taken, with the exception of a small section (less than 0.25 x 0.25 m square). The sample that could still be obtained was just over 1 litre (for comparison, samples taken from other, smaller, floor-contexts measured over 100 litres). As this sample is not representative, the macro-botanical evidence on its own cannot support the interpretation of storage of cereals in this context. The surface had been well sampled for zooarchaeological remains and has yielded a lot of information on meat consumption of the

⁵⁸ M. Zohary and N. Feinbrun-Dothan, *Flora Palaestina*, volumes 1–4 (Jerusalem, 1966).

⁵⁹ R. T. J. Cappers, R. Neef, R. M. Bekker, F. Fantone, and Y. Okur, Y. *Digital atlas of traditional agricultural practices and food processing* (Groningen, 2016); R. T. J. Cappers and R. Neef, *Handbook of Plant Palaeoecology* (Groningen, 2012); R. T. J. Cappers, R. Neef, and R. M. Bekker, *Digital Atlas of Economic Plants* (Groningen, 2009).

⁶⁰ A. M. Hansen, B. J. Walker, and F. B. J. Heinrich, “‘Impressions’ of the Mamluk agricultural economy: Archaeobotanical evidence from clay ovens (*tābūn*) at Tall Hisban (Jordan),” *Tijdschrift voor Mediterrane Archeologie* 56 (2017), in press.

⁶¹ See Hansen, “The agricultural economy of Islamic Jordan.”

garrison residents, which can be contrasted with meat consumption within the village.⁶² In this context, only a few hard/bread wheat grain kernels, hard wheat rachis internodes, straw remains, and wild seeds were encountered. Future excavation of similar and other contexts (e.g., cooking areas) from the citadel will help create a fuller image of the range of crops and foodstuffs that were available to the elite that inhabited the citadel. Such botanical finds may well include more luxury or “exotic” items, analogous to the zoological finds in the citadel.

Field O

O13, a continuation of O9, is believed to be a courtyard outside of a Mamluk house and was excavated in the 2016 field season. One main context (Locus 5) was a deposit that contained a high concentration of ash along with *tābūn* fragments; other *tābūn* fragments were found on a surface (Locus 16) that was on the same level as the bottom of the pit. Because of the nature of the finds, similar to the case of M1, we may assume that this area held the function of an outside cooking area for some time and then functioned as an area for domestic cooking waste. Reed culm was found most often in contexts in O13; possibly this material was used as a type of fuel. Samples from O9 consisted of beaten earth surfaces (such as Locus 18) and the finds indicate domestic cooking waste.

O14, a continuation of O10, is an archetypical, barrel-vaulted farmhouse from the Mamluk period, where “living surfaces” could be sampled. This includes a beaten earth surface in the southeast quadrant of the square (Locus 6) that lies directly above a plaster surface (Locus 7), both of which were sampled.

Contexts from O9/O13 and O10/O14 all reflect signals of domestic cooking waste. Cooking and discard could have taken place during the summer months, while in the winter cooking could have taken place indoors, also helping to heat the house, while food waste was discarded outside the house.

Field M

Squares M1 and M8 were particularly rich in archaeobotanical finds. M1 is a waste disposal area located outside the north wall of the tell that was excavated in 2014, rich in well-preserved *tābūn* fragments,⁶³ food waste, and cereal processing waste, including straw/culm, rachis internodes, and charred chaff (the palea/lemma, also known as the hull or husk). An ash layer (Locus 10) revealed extremely rich macro-botanical deposits that included *tābūn* fragments and some of the site’s best preserved botanical remains, including two complete *Vicia faba* seeds. Alongside rich archaeobotanical remains *tābūn* fragments were also found in a trash deposit (Locus 12) and in a possible cooking area (Locus 13). Though many of the features in this square were disturbed, and it is difficult to locate the

⁶² See Corbino, this article.

⁶³ Hansen, Walker, and Heinrich, “‘Impressions’ of the Mamluk agricultural economy.”

original position of the *ṭābūn*, there seems to be evidence of burning, either for the purpose of cooking, trash disposal, or both.

M8 is a narrow vaulted chamber (ca. 2.5m wide) situated mid-slope on the northern slope of the tell that was excavated in the 2014 and 2016 field seasons. The chamber was a Mamluk-era repurposing of a much larger Early Islamic domestic structure (a room or perhaps a full building) built on top of the bedrock. In the Middle Islamic period, this larger structure was divided by a large wall (Wall 3), which was supported by a barrel vault, thus creating M8. The chamber opens downslope into a cistern and is built against a row of similar narrow, vaulted chambers oriented downslope towards water collection installations. M8 is built on top of a subterranean vaulted chamber of an unknown date. The space went out of use sometime in the late Mamluk period after the vault collapsed, likely the result of the mid-fourteenth-century earthquake, which led to the abandonment of the citadel on the top of the tell.

The function of M8 would appear to be related to cooking activities, since there was a *ṭābūn* built against Wall 3 and because of the finds in Locus 7 (Pail 36)⁶⁴ and Locus 19 (Pail 52).⁶⁵ These loci could either represent two separate phases, a chamber for cooking and subsequent use of the space as a domestic waste area, or both a part of the same activity (cooking) since they're located in different parts of the excavation square. The combination of high concentrations of botanical remains both in phase with *ṭābūn* fragments (Locus 19) and in later phases, found alongside (macro- and micro-) botanical remains indicate cooking waste (florets, seeds, endocarps) and fuel use (/waste), including dung, threshing remains (cereal culm/

⁶⁴ Locus 7 (pail 36), which was sealed off by collapse of the vault, was a beaten earth surface which was cut by a possible pit that was filled with loose earth containing large pockets of ash (Locus 8) and terra rossa soil (Locus 9), in some places up to 30cm thick. Sherds from this context date from the Late Byzantine and Early Islamic to the Middle Islamic, including glazed wares, while the Early Islamic wares were dominant. Locus 7 also contained many nari pockets of eroded limestone. From this context, we have interpreted that chamber M8 was used in the Mamluk period for an activity that generated a lot of ash, but it was in a space that was originally built much earlier, with earlier debris moved aside. The room was likely exposed to repeated winter rains, which may have created the extensive nari pockets. What is an alternative interpretation is that the nari was the result of repeated heat from cooking activities.

⁶⁵ Locus 19 (pail 52) was a soil layer right on top of the bedrock, and perhaps functioned, in part, as a levelling layer for the western divisions wall (Wall 3). The earth contained many ash concentrations, midden and ash lenses, and terra rossa (similar to Locus 7), including sherds ranging in date from Late Byzantine to Middle Islamic periods. The Middle Islamic wares were dominant and included mostly HMGP jars, bowls, and cooking pots; many complete glazed vessels were present and entire domestic assemblages were represented. This context also includes *ṭābūn* fragments and many tesserae. Though the tesserae were not burned, a possible interpretation is that some of them could be part of an erosional collapse from the tell summit from the mosaics of the Byzantine basilica upslope from this chamber. However, see discussion in the section on Field A.

straw and culm bases/roots, and rachis internodes). It follows from the phasing that some time after the *ṭābūn* fell out of use, the chamber was converted to a refuse disposal area as attested by the pottery of a typical domestic assemblage and many coins, perhaps combined with occasional erosion debris sliding downslope. The presence of discolored crème green-colored HMGP Ware sherds indicate that the collapse of the barrel-vaulted roof, likely caused by an earthquake, resulted in the chamber being regularly waterlogged during the winter rainy season.⁶⁶

Animal Bones

The zooarchaeological investigation at Tall Ḥisbān aims to define social status indicators and food supplies in fourteenth-century Mamluk society. Furthermore, attempts are made to identify evidence of landscape exploitation and environmental changes in the site's surroundings at that time. Although zooarchaeology is a well-developed research field, studies of animal remains recovered from Mamluk sites are still rare. However, the results that can be achieved by zooarchaeological analyses are particularly suited to enquire into the environmental and cultural changes that occurred throughout the Islamic period.

The animal bones and teeth analyzed here were recovered during four excavation seasons at Tall Ḥisbān.⁶⁷ Samples dated to the fourteenth century, corresponding to the Mamluk occupation of the site, were collected from the citadel as well as from the village located on the tell slopes. More specifically, the archaeological remains from the citadel come from two adjacent squares, 1 and 2, of Field L, investigated in 2001. They are located near the main gate of Ḥisbān's Mamluk citadel. The faunal materials were recovered from a barrel-vaulted storeroom in the area of the Mamluk governor's palace inside the citadel. The ceramics collected suggest this was a high-status site; indeed, local wares were associated with imported glazed ware. The inscriptions on vessels indicate that they were made-to-order for military officials. The room was probably used by the garrison stationed there during the fourteenth century.⁶⁸

In the village, archeological investigations demonstrate a long-term occupation. The animal remains dated to the Mamluk period were recovered from contexts located in fields C, M, and O. These areas show remains of Mamluk structures probably associated with domestic activities. Field C was investigated in

⁶⁶ For a full description of the pottery and scientific analyses, see Bethany J. Walker, Tarina Greer, Reem al-Shqour, Aren LaBianca, Robert D. Bates, Jeffrey P. Hudon, Warren Schultz, Julian Henderson, Chiara Corbino, Sofia Laparidou, Annette Hansen, and Øystein S. LaBianca, "Tall Ḥisbān 2016 Excavation Season: Household Archaeology in the Medieval Village," *Annual of the Department of Antiquities of Jordan* 59 (2016–17): in print.

⁶⁷ The analyzed remains were collected in 2001, 2004, 2013, and 2014.

⁶⁸ Walker, *Jordan in the Late Middle Ages*.

2004. The analyzed remains were collected from square 102. C102 would appear to have been a kitchen in the Mamluk period. All the analyzed specimens come from contexts associated to the use of the kitchen: a plaster floor (locus 12), the deposit below the plaster floor (locus 13), and a *ṭābūn* (locus 15). The animal remains collected from field M come from square 8. M8 is a narrow vaulted chamber investigated in 2013 and 2014.⁶⁹ The analyzed remains come from a beaten earth surface corresponding to the loci 5, 6, and 7. They covered the entirety of the M8 square. Square 9 and 10 from field O were investigated in 2013.⁷⁰ O9 is probably a courtyard outside of a Mamluk house. Faunal remains collected from locus 10 are associated with a number of pottery sherds and a Mamluk coin. O10 is a barrel-vaulted Mamluk farmhouse. A few faunal remains come from a plaster floor (locus 13).

The identification of faunal remains was based on specific atlases⁷¹ as well as on the project reference collection held in Madaba. When the distinction between sheep and goat was not possible, the bones were attributed to the sheep/goat group. The number of identified specimens (NISP) and minimum number of individuals (MNI) were used to assess the relative abundances of taxa. MNI counts were obtained taking into account ontogenetic age and size.⁷² The frequencies of anatomical elements have been tallied to calculate the minimum number of skeletal elements (MNE). The MNE was obtained considering the selected diagnostic zones for each bone,⁷³ corrected by the age and side.

The age-at-death estimations of sheep/goat and cattle were based on long bone epiphyseal fusion,⁷⁴ as well as on tooth eruption and wear stages.⁷⁵ Teeth ontoge-

⁶⁹ For further information about field M8 see Hansen in this article.

⁷⁰ For detailed information about field O9 and O10 see Hansen in this article.

⁷¹ Joachim Boessneck, Hanns-Hermann Müller, and Manfred Teichert, "Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* Linné) and Ziege (*Capra hircus* Linné)," *Kühn-Archiv* 78 (1964): 1–29; Elisabeth Schmid, *Atlas of Animal Bones* (Amsterdam, 1972); Robert Barone, *Anatomia comparata dei mammiferi domestici: Osteologia* (Bologna, 1976); and Alan Cohen and Dale Serjeantson, *A Manual for the identification of bird bones from archaeological sites* (London, 1986).

⁷² Sandor Bokonyi, "Archaeological problems and methods of recognizing animal domestication," in *The domestication and Exploitation of Plants and Animals*, ed. Peter J. Ucko and G. W. Dembley (Chicago, 1969), 219–29.

⁷³ Simon Davis, *The Archaeology of Animals* (New Haven, 1987), 35.

⁷⁴ Elisabeth J. Reitz and Elisabeth S. Wing, *Zooarchaeology* (Cambridge, 1999).

⁷⁵ Annie Grant, "The use of tooth wear as a guide to the age of domestic ungulates," in *Ageing and sexing animal bones from archaeological sites*, ed. Bob Wilson, Caroline Grigson, and Sebastian Payne, British Archaeological Reports 109 (Oxford, 1982), 91–108.

netic ages were obtained adapting Grant's⁷⁶ wear-scoring technique to Payne's,⁷⁷ following Greenfield and Arnod's⁷⁸ schemes for sheep/goat. Bird bones were divided into two broad age groups: "immature" and "mature," depending on the observed skeletal level of ossification. Sexing animal bones is important for reconstructing past husbandry practices. For mammal bones, sexing was based on morphological criteria. Female domestic fowls were identified by the presence of medullary bone, which forms during the egg-laying period. The distribution of osteopathologies was recorded. They have been grouped in three broad categories: pathologies of the oral cavity, those associated to keeping/working stresses, and traumas.⁷⁹ Different types of bone-surface alterations have been tallied: weathering,⁸⁰ trampling, root etching, abrasion/polishing, carnivore and rodent ravaging evidence (bites, gnawing marks) and human-derived modifications. The last modifications include carcass processing marks, such as intentional fracturing, evidence of skinning, defleshing, and portioning through cutting and chopping, as well as combustion traces.

What follows is an analysis of three components of agrarian culture best suited to such a coordinated, multi-disciplinary approach: land use (what to sow, how to water), diet (differentiating between that of the soldiers' garrison in the citadel and the peasants living in the village below), and agricultural economy. Because of the differences in methods, and even greater differences in the scholarly language used by archaeologists and natural scientists, these sections will begin with the historio-archaeological perspective, as it has been filtered by the archaeologist's understanding of the archaeobotanical and faunal record, followed by the perspectives of the archaeobotanists and zooarchaeologist, as they have been rewritten after many months of conversations with the co-authors and in consultation with the archaeologist for interpretations of stratigraphic contexts.

⁷⁶ Ibid.

⁷⁷ Sebastian Payne, "Kill-off patterns in sheep and goats: the mandibles from Aşvan Kale," *Anatolian Studies* 23 (1973): 281–305.

⁷⁸ Haskel J. Greenfield and Elisabeth R. Arnold, "Absolute age and tooth eruption and wear sequences in sheep and goat: determining age-at-death in zooarchaeology using a modern control sample," *Journal of Archaeological Science* 35 (2008): 836–49.

⁷⁹ Laszlo Bartosiewicz, "Pathological lesions on prehistoric animal remains from southwest Asia," in *Archaeozoology of the near east V*, ed. H. Buitenhuis, A. M. Choyke, M. Mashkour, and A. H. Al-Shiyab (Groningen, 2002), 320–36.

⁸⁰ Anna K. Behrensmeyer, "Tophonomic and ecologic information from bone weathering," *Paleobiology* 4 (1978): 150–62.

Land Use

The Culture(s) of Grain Cultivation

We focus here on the differentiation between wheat and barley, which, as the textual record suggests, served different purposes in the local and imperial economies and was the tax foundation of the Mamluk state. Wheat (and apparently we mean here “hard” wheat, or durum wheat, although it is not specified as such in period textual sources) was the most efficiently processed and transported and was, thus, the most marketable. It was also taxed at the highest rate, reflecting its market value on the state level. Barley was used for both human consumption and as fodder; during military campaigns in the region, Syrian villages were required to provide certain quantities of barley for the amirs’ horses. Multiple wheat and barley sub-species are clearly distinguishable in the archaeobotanical record and are often retrieved at the site from differentiated spatial contexts, suggesting different economic functions. At Tall Ḥisbān, hard wheat was the most common of wheats, but hulled barley was the dominant among all cereals.

The results thus far of the on-going phytolith analysis, on their own, suggest a couple of important trends in local grain production and consumption. From mid-fourteenth-century deposits on the site, it appears that there was considerably more wheat stored in the citadel storerooms than barley (a spatial context suggestive of tax collection and transport), while in the village itself the relative importance of the two cereals was less pronounced. (The barley phytoliths recovered from the farmhouse courtyards may reflect use as fodder, and in the households as family consumption, as the crop processing of the samples suggests.) The second pattern is equally important: both wheat and barley husk phytoliths with multiple cells (a formation that can result from excessive intake of water) were recovered from both citadel (midden, or trash deposits) and village (farmhouses and village storage facilities) contexts of the mid-fourteenth century. In other words, as far as the phytolith evidence is concerned, for a brief period (perhaps a decade or more), cereals were irrigated at Ḥisbān.⁸¹ However, this date range will need to be further confirmed with radiocarbon dating of material from the same context. These irrigated cereals were marketed and also locally consumed. In other words, both wheat and barley were “economic plants” that played important, though arguably different, roles in the Mamluks’ agricultural economy. Whether irrigation for agricultural intensification was under imperial order (to increase revenues) or

⁸¹ The chronology is based on the stratigraphic context. The phytolith samples with irrigation signals in the citadel come from the storeroom, the vault of which collapsed in an earthquake in mid-century, essentially sealing the contents of the room. In the village, the contexts are similar, sampling under collapsed vaulting and on floors. The irrigation signals have not been identified in samples of earlier or later periods (that is, strata below or above these loci).

peasant resolve (as a resilience strategy to guarantee a harvest during dry periods) will be discussed below.

The analysis of macrobotanical remains allows us to refine our picture of cultivation. Barley (2-row hulled barley) was the most important local crop, namely for use as fodder, in the building of *tābūns* for baking bread, and for human consumption. We can argue that, in contrast to Egypt, at this particular site in Syria barley was the most important economic crop, from both a state and local perspective. There were at least four different kinds of cereals produced in the fields at Ḥisbān in the fourteenth century, including three different kinds of wheat: durum (or “hard”) wheat (which was dominant in the citadel storeroom), emmer wheat, and “bread wheat.” This kind of diversification of grain production leaves no trace in the textual record, thus far in our study. From the perspective of a government official, it is all “wheat” (*qamḥ/ḥinṭah*). Today Jordanian farmers cultivate five different kinds of wheat and barley. It is a stress response, as certain kinds of wheat perform better under certain soil and hydrological conditions. They also have different market values; durum wheat has been since Roman times the grain-of-choice, for its hardness (facilitating grinding/milling), transportability, and, we might argue, taste. It also pulled the highest prices.

In a recent study, economic historian and archaeobotanist Frits Heinrich has made a case for the relationship between the shift from emmer wheat to hard wheat and the shift from (primarily) subsistence-based production strategies to increasingly market-oriented ones. Emmer wheat is a hulled wheat and its husk (colloquially the chaff) is tough and well attached to the kernel; therefore the husk does not come off during threshing and has to be removed during a separate step, dehusking, which is followed by a second winnowing. As dehusking may damage the kernel, this process is usually only executed in small batches prior to further processing (e.g., milling) or food preparation. While the husk protects the kernel from fungus and animal infestations during storage, it also makes the grain bulky, as the inedible husks take up much space. In transport this is a disadvantage, as the edible weight of a transported volume is fairly low. In naked wheats, such as durum wheat, on the other hand, the chaff is very loosely fitted around the kernels and it comes off during threshing. Therefore the processing steps dehusking and a second winnowing are unnecessary. Logistically important is that kernels without chaff are far more compact (giving a greater weight to volumes) while the entire volume is edible. This difference in transport efficiency, as Heinrich has shown through measuring and weighing modern samples, in the case of emmer and durum wheat amounts to 50%, making durum wheat far more attractive for transport (interestingly even hulled barleys exhibit a similar attractiveness). Therefore, a commercial farmer who wishes to produce and export for the market, or a state (in this case study, the Roman state) that seeks to move

and redistribute tax-grain may prefer durum wheat due to its lower processing and transport costs, while a farmer who produces for the subsistence of his family (and who is neither concerned with transport nor wage costs) may give preference to emmer wheat, as its husks improve storability and reduce the risk of loss through spoilage and predation. Heinrich does note that many Roman farmers likely combined these two strategies, producing emmer wheat for their own consumption and durum wheat for the market. Based on the study of published data and a discussion of various crop-chronologies (in which shifts in cereal-selection are documented) Heinrich has argued that the historical trend shows that the shift from emmer to hard wheat in the Mediterranean, including Egypt and the Levant, took place between the Hellenistic period and Late Antiquity under the influence of increased economic integration, globalization, and economic growth.⁸² According to textual records, however, emmer wheat was grown in Yemen in the fourteenth century.⁸³

The purely archaeological evidence for grain cultivation, outside of the spatial context of the archaeobotanical samples, is minimal. We cannot identify the grain fields of the Mamluk period: the agricultural land around the site is still “under the plow,” and there is as yet no archaeological technique (such as identifying “relic field lines” in aerial photos or the presence of abandoned terrace walls during archaeological surveys) to allow us to find and explore the ancient fields under these conditions. The hydrological systems that might have watered these fields, however, have survived.

The entire site of Tall Ḥisbān sits atop what is best described as a vast bed-rock-cut, underground water tank: a system of caves and interconnecting tunnels that have been modified for use as cisterns, canals, and a reservoir since the Iron Age.⁸⁴ While a detailed study of the Mamluk water systems is currently underway, a few preliminary observations can be made at this point.⁸⁵ If the holding capacity of the cisterns and reservoirs is a fair indication, water use and

⁸² F. B. J. Heinrich, “Modelling Crop-Selection in Roman Italy: The Economics of Agricultural Decision Making in a Globalizing Economy,” in *Rural Communities in a globalizing economy: new perspectives on the economic integration of Roman Italy*, ed. Tymon de Haas and Gijs W. Tol (Leiden, in press). Cf. F. B. J. Heinrich and W. P. van Pelt, “Graantransport en graanprijzen in Ramessidisch Egypte: Het recto van P. Amiens en P. Baldwin gekwantificeerd,” *Tijdschrift voor Mediteranne Archeologie* 56 (in press) for an example from Ramesside Egypt. For a discussion of what this means for Watson’s theory of the Arab Agricultural Revolution, see Hansen, “The Agricultural Economy of Islamic Jordan.”

⁸³ We are grateful to Dan Varisco for this information.

⁸⁴ Many of these caves have, historically, been repurposed for grain storage when the installations went out of use for water storage.

⁸⁵ More comprehensive studies of this water system can be found in Walker et al., “Tall Ḥisbān 2013 and 2014 Excavation Seasons,” and Bethany J. Walker, “The Struggle over Water: Evaluating

development at Ḥisbān peaked in the Iron Age, Roman, Byzantine/Umayyad, and Mamluk periods. Many of the cisterns and feeder channels built in the Late Antique and Early Islamic periods either continued to be in use or were renovated and put back into use in the thirteenth and fourteenth centuries. This was particularly true for the household cisterns of the farmhouses on the tell slopes and immediately downslope. Two large, “urban” cisterns south of the tell, originally Byzantine constructions, were cleaned, re-plastered, and put again to use during the Mamluk era.⁸⁶ At least three cisterns (two on the summit and one on the west slope) were built anew at this time.

Preliminary mapping and study of the hydrological system of the citadel and medieval village suggest more intensive water harnessing and coordinated distribution, and perhaps investment in larger-scale irrigation, at least for a period, in the fourteenth century. While most of the fields beyond the tell relied on the run-off irrigation characteristic of rain-fed agriculture, the settlement itself, the garrison, and it seems some nearby fields were serviced by a complex and vast system of cisterns and channels, fed from rooftops and connecting the citadel with the village. These may have supplemented the traditional methods of run-off irrigation practiced in dry farming communities (a kind of rainwater irrigation management). The water survey, cistern mapping, and preliminary study of soil deposits from the subterranean chambers together provide evidence of fast-moving water and irrigation in the fourteenth century, potentially corroborating the phytolith evidence for short-term irrigation of cereals at the site.

There is no archaeological or textual evidence, however, that the heightened investment in irrigation was a state initiative, though it likely was.⁸⁷ This renewed interest in irrigation cannot be separated from the larger picture of revitalization

the ‘Water Culture’ of Syrian Peasants under Mamluk Rule,” in *Developing Perspectives in Mamluk History*, ed. Yuval Ben-Bassat (Leiden, 2017), 287–310.

⁸⁶ They are a cave-cistern complex found at the southern base of the tell and connected with the Iron Age reservoir in Field G (dubbed the “Abu Nur Cave” in most preliminary field reports) and Adīb Abu Shmeis, “Taqrīr Kashf Arḍi: Khizān Mā’ min al-‘Aṣr al-Bizāntī al-Mubakkir (Ḥisbān)” (unpublished report, Department of Antiquities of Jordan, April 2005).

⁸⁷ With the exception of *waqfiyāt*, there are practically no textual references to rural irrigation systems beyond urban centers, as their financial status was ambiguous. Although water was a commodity in the Ottoman period, the shares of which (periods of time of irrigated water could be used) could be bought and sold, the physical facilities for water capture, transport, and storage were, apparently, not. Thus, cisterns and canals do not appear in tax registers. The defters provide only indirect evidence for irrigation, by enumerating crops requiring irrigation, such as fruits and viticulture, or taxable facilities or installations, including water mills and mill stones. Family cisterns, however, raised the value of the land they were on, were of high social value, and could be bequeathed. (For more on the archaeology of the family cistern, see Walker, “Struggle Over Water.”)

of the hydrological systems site-wide, which indicate increased water demand.⁸⁸ Although cereals in Syria are occasionally irrigated during years of drought, under the initiative of local farmers, the expansion of irrigation systems at Ḥisbān coincided with a “wetter” climatic period (higher rainfall, lower temperatures).⁸⁹ Irrigation of cereals in the fourteenth century was not necessitated by climatic conditions, but it may have been a response to increased demands by the government for higher yields of both wheat and barley. In brief, the grain culture of fourteenth-century Ḥisbān can be characterized by diversification of grain cultivation (a resilience strategy maintained by local communities to address market and subsistence needs), occasional irrigation of cereals in support of intensification of grain production, or to guarantee a certain level of production (local practice under state pressure), and an economic importance of barley.

Physical Evidence of Land Use

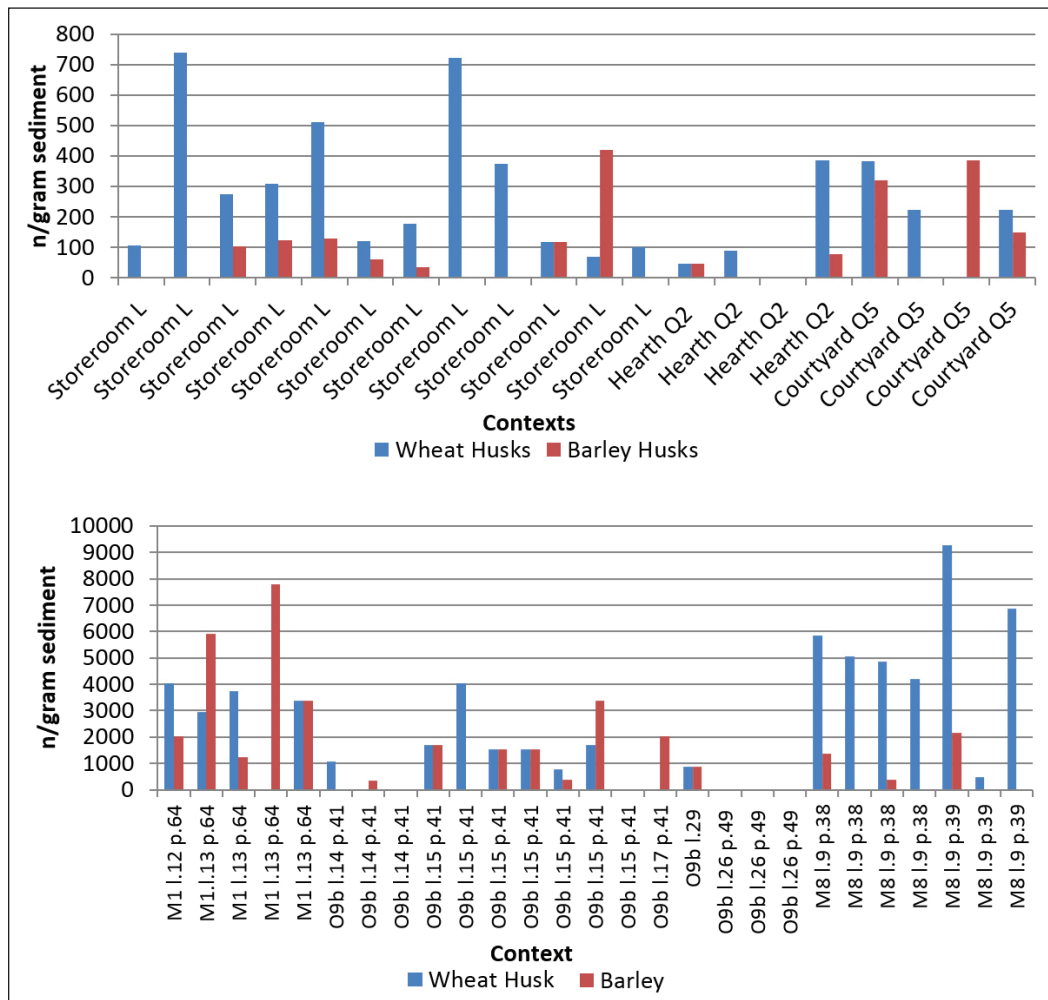
A Phytolith Narrative

Phytoliths derived from Tall Ḥisbān identified two major economic plants of this period of study, wheat and barley, given that their identification is possible using specific morphological criteria of multi-cell phytoliths. Of the economic plants that could be identified in the phytolith record, *Triticum* sp. (Wheat) and *Hordeum* sp. (Barley), these were further clarified with the macro-botanical data, which attested three subspecies of wheat and one subspecies of barley (see Hansen, this article). Irrigation signals were identified in many samples of the same period from both the citadel and farmhouses (Graphs 1a and b).

Graph 1a shows the numbers per gram sediment of wheat (*Triticum* sp.) and barley (*Hordeum* sp.) husk phytoliths from the citadel, present within the storeroom of the Mamluk governor’s residence, Field L, Field Q2, and Field Q5. Wheat husk silica skeletons are present in large numbers within all samples derived from the governor’s storeroom. This could suggest that hulled wheat was brought to the site and stored in storerooms in the husk. As in the macro-botanical samples the dominant wheat was the free-threshing wheat, most notably hard wheat, the large quantities of wheat cereal chaff in the storeroom may suggest two further scenarios: that wheat was stored before coarse and/or fine sieving of the

⁸⁸ Whether this demand was the result of population growth, agricultural intensification, or both, can only be determined by further study of the water systems at Ḥisbān and comprehensive mapping of them. The sudden growth of the village, and the spatial differentiation of its development, are not organic and should be considered against the backdrop of the needs of the citadel in the fourteenth century (Walker, “Planned Villages”). One could argue the same for development of the water systems that provided the settlement infrastructure.

⁸⁹ This should be contrasted with cycles of drought at the end of the century. For a review of the literature on climatic history, see, Walker, *Jordan in the Late Middle Ages*, 225, n. 341.



Graphs 1a and b. Wheat and barley husk multi-cells phytoliths.

free-threshing wheats, or that storage areas were also used for certain periods for the storage of threshing remains from durum wheat. Threshing remains of free-threshing wheats are collected on the threshing floors (see Walker in this paper) and are used to make dung-cakes used for fuel.

The macro-botanical samples collected from the site are also dominated by hulled barley. Barley and wheat husks phytoliths were also recovered from the storeroom, although barley husks were present in smaller quantities. Barley husks of hulled barleys are far more tightly fitted around the kernel and do not come off during threshing (and are therefore not included in threshing waste). Such material would therefore largely not end up in a threshing-remains storeroom in bulk. However, the presence of smaller quantities of barley husks, and the presence of

both wheat husks (which according to the macro-botanical evidence derived from free-threshing wheats) and barley husks (which derived from hulled barley), two very different crop types to be grown and/or processed together,⁹⁰ may indicate that some kind of mixing took place after their processing for the production of dung pies or the storage of animal fodder.

The phytolith record from Tall Ḥisbān, derived from the farmstead (Field O9), revealed that peasants had access to wheat and barley crops. Wheat and barley husk phytoliths are present in high densities in the midden found inside the single-room farmhouse (Graph 1b). Graph 1b shows the numbers of grass husk phytoliths from Fields M1, M8, and O9. The phytolith records showed that wheat and barley husks are found in all fields sampled, including the citadel midden (Field M1), the vaulted building (Field M8), and the farmhouse (Field O9). The barrel-vaulted structure of Mamluk date, Field M8, contains large amounts of wheat husk phytoliths, while barley husk phytoliths are found in smaller amounts in Field M8 than in Field M1. Field M1 is rich in wheat husk phytoliths, although these are present in slightly lower amounts than in Field M8. On the contrary, barley husk phytoliths are present in higher amounts in the fill layers of Square M1, compared to Square M8 (Graph 1b). Barley husk phytoliths are present in all of the samples derived from the two fill layers in Square M1, while wheat husk phytoliths are absent from one sample. Also, high densities of identified wheat and barley husks and lower relative absolute counts of wild grass husks inside the barrel-vaulted structure (Square M8) indicated the deposition, processing, and/or storage of clean cereal crop in this context.

Also, it appears from the phytolith records that local state officials depended on the storage and management of the agricultural grain crops (Graph 1a), but also on the production and management of agricultural crop by-products such as fodder (Graph 1a). These were valuable commodities that would sustain livestock for meat consumption at a subsistence level in the citadel, for the production of animal by-products, and for the storage of animal dung used for fuel and manure (see Corbino and Hansen in this paper).

Phytolith evidence for irrigated cereals showed that irrigated cereal crops were present in high densities on site (Graph 1). Large multi-cell cereal phytoliths in-

⁹⁰ Glynis Jones and Paul Halstead “Maslins, mixtures and monocrops: on the interpretation of archaeobotanical crop samples of heterogeneous composition,” *Journal of Archaeological Science* 22 (1995): 102–14; R. T. J. Cappers, F. B. J. Heinrich, S. Kaaijk, F. Fantone, J. Darnell, and C. Manassa, “Barley Revisited: Production of Barley Bread in Umm Mawagir (Kharga Oasis, Egypt),” in *Current Research in Egyptology 2013: Proceedings of the Fourteenth Annual Symposium*, ed. K. Accetta, R. Fellingner, P. Laurenço Gonçalves, S. Musselwhite, and W. P. van Pelt, (Oxford, 2014), 49–63.

dicate some level of irrigation.⁹¹ Interestingly, large multi-cell cereal phytoliths were present in higher densities in the governor's storeroom (Field L) (Graph 1a) and the citadel's midden (Square M1) than in the domestic contexts in the medieval village. Whether the presence of larger amounts of wheat husk phytoliths in the storage room (Field L) inside the citadel indicates that the distribution of irrigated cereal crop was managed and controlled by the local governor remains an interesting line of future research.

A Macrobotanical Narrative

Cereal cultivation, probably in conjunction with pulse cultivation, was the primary activity that took place on the arable land, likely followed by the cultivation of fodder crops. Vegetables would have been cultivated on smaller plots, or possibly on the edges of fields. Fruit and nut trees could either have been scattered throughout the agricultural landscape or have been concentrated on the hillsides of the tell. Future studies, such as the analysis of the wood charcoal, indicating the most common available wood sources for fuel at the site, will add to the narrative on the microenvironment at Tall Ḥisbān.⁹² What follows is a preliminary analysis of the macrobotanical remains, as they reveal patterns in land use.

Taphonomy

What kinds of archaeobotanical remains are found in the assemblage are a result of the formation processes (i.e., human activities) and the type of preservation of the remains (i.e., taphonomy). There are four main ways in which macro-archaeobotanical remains can be preserved: charring/carbonisation, mineralisation, desiccation, and waterlogging.⁹³ The most common type of preservation at Tall Ḥisbān is carbonisation (or charring), followed by mineralisation and desiccation (although the latter is only very limited). There are no waterlogged archaeobotanical remains at the site. Because of this, more robust remains are recovered here most often in assemblages, which include seeds, fruits, glume bases, rachis internodes, culm/straw, and wood charcoal. Nevertheless, more fine plant parts,

⁹¹ It can also indicate a wetlands environment. In Jordan, however, this is not likely the case. One should note that the Jordanian landscape, as throughout Greater Syria, is characterized by a diversity of micro-environments; thus engaging in (some) irrigation practices in order to grow crops efficiently is a fairly common prerequisite. Subsequently, at most sites there will be species that are indicative of irrigation being practiced without conveying much on the absolute “dryness” or “wetness” of the natural environment. We may thus conclude that the environment, like most of Jordan, was dry enough to warrant irrigation or other rainfed/dryland watering strategies, at certain times and under certain conditions.

⁹² Hansen, “The Agricultural Economy of Islamic Jordan.”

⁹³ For a detailed description on the types of preservation and how they occur, see Pearsall, *Paleoethnobotany*.

such as cereal awns and grape pedicels, can also be recovered. In contrast to this, extremely arid environments such as found in much of Egypt allow for more plant remains and plant products to be preserved in very good condition. Among the latter are textiles and other fibrous materials, papyri, and even breads.⁹⁴ In areas where desiccation is not the prevalent preservation mode, archaeobotanical evidence for bread is generally scarce. Though rare and difficult to recognize, charred bread remains can survive in areas where cooking or baking took place. Several food remains from Mamluk Ḥisbān are being analysed to ascertain if they can be positively be identified as bread.

Daily life activities ranging from the harvest to the processing and consumption of plant remains (either as food, fodder, or fuel, and whether intentional or unintentional), and the function of a context and the activities that took place there, determine the formation of its archaeobotanical assemblage. For example, the archaeobotanical assemblage of a hearth may consist of elements originating from cooking waste (seeds, processed food stuffs), or fuel (dung, wood, cereal processing waste, charcoal), but may also include accidental inclusions in the food or fuel (e.g., plant material in dung that survived the digestive tract).⁹⁵

⁹⁴ For a discussion on the taphonomy of archaeological bread and a survey of where archaeological bread has been found so far, see Delwen Samuel, "Bread in Archaeology," *Civilizations* 49 (2002): 27–36.

⁹⁵ Hansen, Walker, and Heinrich, "'Impressions' of the Mamluk agricultural economy." For a relevant discussion, see Michael Wallace and Michael Charles, "What goes in does not always come out: The impact of the ruminant digestive system of sheep on plant material, and its importance for the interpretation of dung-derived archaeobotanical assemblages," *Journal of Environmental Archaeology* 18, no. 1 (2013): 18–30, and Mans Schepers and Henk Van Haaster, "Dung matters: An experimental study into the effectiveness of using dung from hay-fed livestock to reconstruct local vegetation," *Journal of Environmental Archaeology* 20, no. 1 (2015): 66–81.

Table 1. Identified plant taxa from macro-botanical analysis in Mamluk contexts

Crop species have been divided into three categories, cereals, pulses, and fruit/nuts, while common arable grasses, wild species, and other economic plants have also been listed in their respective categories. Note that some families, genera, and species have more than one growing season.

CEREAL CROPS

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part
<i>Hordeum vulgare</i> (hulled)	Hulled Barley	Florets, rachis internodes
<i>Hordeum vulgare</i> cf. ssp. <i>distichum</i> (hulled)	2-row Hulled Barley	Florets, rachis internodes
<i>Triticum turgicum</i> ssp. <i>durum</i>	Durum/Hard Wheat	Grain kernels, rachis internodes
<i>Triticum turgicum</i> cf. ssp. <i>dicoccon</i>	Emmer Wheat	Grain kernels, glume base
<i>Triticum aestivum</i> ssp. <i>aestivum</i>	Bread Wheat	Grain kernels, rachis internodes
<i>Triticum turgicum</i> ssp. <i>durum</i> / <i>Triticum aestivum</i> ssp. <i>Aestivum</i>	Hard/Bread Wheat	Chaff (Palea/Lemma), Rachis internodes
<i>Hordeum vulgare</i> / <i>Triticum turgicum</i> ssp. <i>durum</i> / <i>Triticum aestivum</i> ssp. <i>aestivum</i>	Barley/Wheat sp.	Culm/Straw and Culm bases/Roots
<i>Cerealia</i>	Cereals	Indeterminate grain kernels

PULSE CROPS

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part
<i>Pisum sativum</i>	Common Pea	Seed
<i>Vicia faba</i>	Faba bean	Seed
<i>Vicia ervillia</i>	Bitter Vetch	Seed

<i>Cicer arietinum</i>	Chick Pea	Seed
<i>Lens culinaris</i>	Lentil	Seed
<i>Lathyrus sativus</i>	Grass Pea	Seed
cf. <i>Lupinus albus</i>	White lupine	Seed

FRUIT/NUT CROPS

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part
<i>Olea europaea</i>	Olive	Endocarp, seed
<i>Vitis vinifera</i>	Grape	Seed
<i>Ficus carica</i>	Fig	Seed
<i>Prunus dulcis</i>	Almond	Endocarp
<i>Prunus persica</i>	Peach	Endocarp
cf. <i>Prunus domestica</i>	Plum	Endocarp
<i>Juglans regia</i>	Walnut	Endocarp/fruit

COMMON ARABLE GRASSES

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part	Season	Climate zone
<i>Bromus tectorum</i>	Drooping brome	Seed/fruit	Winter	Temperate
<i>Hordeum vulgare</i> ssp. <i>spontaneum</i>	Wild barley	Seed/fruit	Winter	Temperate
<i>Lolium temulentum</i>	Darnel	Seed/fruit	Winter	Temperate
<i>Phalaris</i> sp.	Canary grass	Seed/fruit	Winter	Temperate

WILD SPECIES

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part	Season	Climate zone
<i>Alkanna</i> sp.	Dyer's alkanet / Alkanet	Seed/fruit	Winter	Temperate
cf. <i>Capparis spinosa</i>	Caper bush / Flinders rose	Seed	Winter	Arid/Semi-arid

<i>Celtis cf. australis</i>	Mediterranean Hackberry	Seed/fruit	Fall / Winter	Temperate
<i>Centaurea sp.</i>	Centaury	Seed/fruit	Winter	Temperate
<i>Echium sp.</i>	Bugloss*	Seed/fruit	Winter	Temperate
<i>Galium sp.</i>	Bedstraw*	Seed/fruit	Winter	Temperate
<i>Medicago cf. sativa</i>	Medick / Alfalfa	Seed	Late summer / Winter	Temperate
<i>Silene sp.</i>	Catchfly	Seed	Winter	Temperate
<i>Ajuga / Teucrium sp.</i>	Bugle weed / Germanders	Seed/fruit	Fall / Winter	Temperate
Brassicaceae	Crucifers / The Cabbage Family	Fruit, seed	Winter	Temperate
<i>Chenopodium sp.</i>	Goosefoots	Seed	Spring / Fall	Temperate
<i>Calendula sp.</i>	Marigold	Seed/fruit	Sown in Winter	Temperate
<i>Malva nicaeensis</i>	Bull Mallow	Fruit	Winter	Temperate
Malvaceae	Mallows	Seed	Winter	Temperate

OTHER ECONOMIC PLANTS

Scientific Name	Common Name	Archaeobotanical Evidence: Plant Part
<i>Carthamus tinctorius</i>	Safflower	Seed/fruit
<i>Coriandrum sativa</i>	Coriander/Cilantro	Seed
<i>Phragmites australis</i>	Common Reed	Culm/Straw

*This name is associated with most but not all species within this genus.

The Archaeobotanical Assemblage

This section briefly discusses the crops and wild plants that have thus far been identified in the Tall Ḥisbān samples (see Table 1). Previous archaeobotanical studies conducted at the site are considered alongside this study.⁹⁶ We will compare the data on the presence and absence of species with that of other archaeobotanical studies for Mamluk-period sites in the area to better interpret the site's macrobotanical assemblage. This data will also aid in expanding upon, and better interpreting, the encompassing, and somewhat limiting, terms used in Mamluk-era textual sources describing common crop species grown in Bilād al-Shām, such as *burr* (wheat), *sha'ir* (barley), and *ḥummus* (chickpea).⁹⁷

Cereals

Four different cereals were encountered at Tall Ḥisbān: 2-row hulled barley (*Hordeum vulgare* ssp. *distichon*), hard wheat (*Triticum turgidum* ssp. *durum*), bread wheat (*Triticum aestivum* ssp. *aestivum*),⁹⁸ and possibly emmer wheat (*Triticum turgidum* ssp. *dicoccon*). Most commonly encountered in the samples were the kernels and rachis internodes of hulled barley (*Hordeum vulgare*). In those cases where the rachis internodes allowed further identification, it was clear these were

⁹⁶ Patricia Crawford and Øystein S. LaBianca, "The Flora of Ḥesbān," in *Heshbon 1974: The Fourth Campaign at Tell Ḥesbān: A Preliminary Report*, ed. James J. C. Cox and Lawrence T. Geraty (Berrien Springs, 1976), 177–84; Patricia Crawford, Øystein S. LaBianca, and Robert B. Stewart, "The Floatation Remains: A Preliminary Report," in *ibid.*, 185–87; Dennis R. Gilliland, "Paleoethnobotany and Paleoenvironment," in *Hesban 02*, 123–42. It should be noted that since these studies were conducted, the methodology for archaeobotanical sampling, flotation, and identification of macro-botanical remains has much advanced, leading to the better retrieval of such remains and their precise identification to a higher taxonomic level. These more advanced methods have been employed in this study.

⁹⁷ Al-Nuwayrī discusses four types of chickpea: white, red, black, or vetch. It could be the case that the "vetch variety" refers to a different pulse all together, and this should be carefully reconsidered when associating the term used by the translator with the most likely choice for the scientific species; see Shihāb al-Dīn al-Nuwayrī, *The Ultimate Ambition in the Arts of Erudition: A Compendium of Knowledge from the Classical Islamic World*, ed. and trans. Elias Muhanna (New York, 2016), 185.

⁹⁸ It should be noted that in the 1974 study conducted by Patricia Crawford, Øystein S. LaBianca, and Robert B. Stewart on pre-Islamic archaeobotanical material the grain kernels identified as "common wheat" were associated with *Triticum aestivum* ssp. *aestivum*. However, as the features of the grain kernels of both bread wheat (*Triticum aestivum* ssp. *aestivum*) and hard wheat (*Triticum turgidum* ssp. *durum*) are indistinguishable when charred and the presence of bread wheat rachis internodes were not attested in this study, this identification is not verifiable. Based on the high frequency of hard wheat rachis internodes compared to bread wheat rachis internodes in Mamluk contexts, we can deduce that hard wheat (not bread wheat) was more economically important in that period.

of the “2-row” sub-species.⁹⁹ The second most commonly encountered cereal in the studied samples was hard wheat. Hard wheat is a naked or free-threshing cereal, which means its chaff (palea and lemma) is easily removed during threshing so it does not require a separate processing step, dehusking, to remove this material as is the case for the hulled cereals. Charred kernels of hard wheat are morphologically indistinguishable from the charred kernels of bread wheat; therefore, they are normally identified as hard/bread wheat. However, charred rachis internodes of these wheats are distinguishable; of all the rachis internodes encountered so far in the assemblage, only one could be identified as bread wheat whereas the others were identified as hard wheat. Emmer wheat is a hulled wheat, and a small number of glume bases and grain kernels that were encountered likely belong to this subspecies. Without a complete glume it is very difficult to make a definitive identification, as the glume bases of emmer wheat and einkorn wheat (*Triticum monococcon* ssp. *monococcon*) when charred may in some cases be indistinguishable.¹⁰⁰ As sampling continues at the site, and more specimens become available, a more definitive conclusion may be reached. The low frequency of emmer wheat, however, is consistent with results from the Mamluk sites of Khirbat Fāris¹⁰¹ and Tall Abu Sarbut in Jordan.¹⁰² This is also an observable trend for the Early Iron Age site of Khirbat al-Mudayna al-‘Aliya.¹⁰³

⁹⁹ In the 1974 study conducted by Patricia Crawford, Øystein S. LaBianca, and Robert B. Stewart on pre-Islamic archaeobotanical material, a quantity of 51 grain kernels were identified as 6-row barley (*Hordeum vulgare* ssp. *vulgare*). However, as the features of grain kernels of both 2-row and 6-row barley are indistinguishable and the presence of 6-row barley rachis internodes were not attested, this identification is not verifiable. For more detailed discussion on the identification of sub-species of wheats and barleys, see Cappers and Neef, *Handbook of Plant Palaeoecology*. The identification of 2-row barley rachis internodes in Mamluk contexts was based on this up-to-date methodology.

¹⁰⁰ Cappers and Neef, *Handbook of Plant Palaeoecology*.

¹⁰¹ It was attested in a few samples in C. Hoppé, “A Thousand Years of Farming: Agricultural Practices from the Byzantine to Early Ottoman Period at Khirbat Faris, the Karak Plateau, Jordan” (Ph.D. diss., Sheffield, 2001) and was absent from all samples analysed in A. M. Hansen, “Evaluating archaeobotanical material from Khirbat Faris: a comparative analysis and review of archaeobotanical data from early to medieval Islamic sites in the Levant and Africa” (M.Sc. diss., Oxford, 2012).

¹⁰² R. Neef, “Plants,” in *Picking up the threads--: A continuing review of excavations at Deir Alla, Jordan*, ed. G. van der Kooij and M. M. Ibrahim (Leiden, 1989), 30–37; Ellis Grootveld, “Archaeobotanical Report of the Excavations of Tell Abu Sarbut,” in *Sacred and Sweet: Studies on the Material Culture of Tell Deir ‘Alla and Tell Abu Sarbut*, ed. Margreet L. Steiner and Eveline J. van der Steen (Leuven, 2008), 197–210.

¹⁰³ Alan Farahani, Benjamin W. Porter, Hanna Huynh, and Bruce Routledge, “Crop Storage and Animal Husbandry at Early Iron Age Khirbat al-Mudayna al-‘Aliya (Jordan): A Paleoethnobo-

As at Tall Ḥisbān, hard wheat commonly was the most important wheat in the region during the Mamluk period; bread wheat and emmer wheat tend to be found only in smaller quantities, suggesting these were secondary cereal crops. Of einkorn wheat, only one regional occurrence is known for this period, at Caesarea Maritima.¹⁰⁴ Hulled barley was a common crop throughout the region in the Mamluk period, though in addition to the 2-row barley found at Tall Ḥisbān, at some sites also the 6-row type was encountered (Dhibān¹⁰⁵ and Khirbat Fāris¹⁰⁶). The apparent importance of barley at Tall Ḥisbān seems to be in line with the situation at other sites in the area (cf. Dhibān¹⁰⁷). Other cereals that are attested at other sites within the region, such as broomcorn millet (*Panicum milliaceum* at Dhibān¹⁰⁸ and at Tall Abu Sarbut¹⁰⁹) and sorghum (*Sorghum bicolor* at Khirbat Fāris¹¹⁰ and at Tall Abu Sarbut¹¹¹), have not been encountered at Tall Ḥisbān. Macrobotanical remains of rice (*Oryza sativa*) are thus far also absent.

Pulses

Pulses are leguminous grain crops whose members are in the Fabaceae family. This group of crops is often underrepresented in the archaeobotanical assemblage because they can almost solely be identified to the genus and species level through their seeds and not their processing waste, such as is the case for

tanical Approach,” in *The Archaeology of Agro-Pastoralist Economies in Jordan*, ed. Kevin M. McGeough (Boston, 2016).

¹⁰⁴ Jennifer Ramsay and Kenneth Holum, “An archaeobotanical analysis of the Islamic period occupation at Caesarea Maritima, Israel,” *Vegetation History and Archaeobotany* 24, no. 6 (2015): 655–71.

¹⁰⁵ For Dhibān, see Alan Farahani, “Sustaining Community under Empire: An Archaeological Investigation of Long-Term Agricultural Production and Imperial Interventions at Dhiban, Jordan, 1000 BCE–1450 CE” (Ph.D. diss., Berkeley, 2014), and Daniel Steen Fatkin, Katherine Adelsberger, Alan Farahani, Sarah Whitcher Kansa, Justin Lev-Tov, Colleen Morgan, Benjamin Porter, Bruce Routledge, and Andrew Wilson, “Digging deeper: Technical reports from the Dhiban Excavation and Development Project (2004–2009),” *Annual of the Department of Antiquities of Jordan* 55 (2011): 249–66.

¹⁰⁶ It was attested in samples analyzed by Hoppé, “A Thousand Years of Farming”; however, it was not attested in samples analysed in Hansen, “Evaluating archaeobotanical material from Khirbat Fāris.”

¹⁰⁷ A high proportion of barley to wheat crops in all phases at Tall Abu Sarbut; see Grootveld, “Archaeo-botanical Report of the Excavations of Tell Abu Sarbut.” For Dhibān, see Farahani, “Sustaining Community under Empire,” and Fatkin et al., “Digging deeper.”

¹⁰⁸ For Dhibān, see Farahani, “Sustaining Community under Empire.”

¹⁰⁹ Neef, “Plants”; Grootveld, “Archaeo-botanical Report of the Excavations of Tell Abu Sarbut.”

¹¹⁰ Hoppé, “A Thousand Years of Farming”; Hansen, “Evaluating archaeobotanical material from Khirbat Fāris.”

¹¹¹ Neef, “Plants”; Grootveld, “Archaeo-botanical Report of the Excavations of Tell Abu Sarbut.”

cereals. The standard processing and preparation methods for pulses also do not offer many opportunities for preservation. This applies in particular to the larger-seeded species, which do not get lost as easily as the small-seeded species during processing.¹¹² The pulses encountered so far are pea (*Pisum sativum*), bitter vetch (*Vicia ervillia*), faba bean (*Vicia faba*), cf. white lupine (*Lupinus albus*), lathyrus (*Lathyrus sativus*), lentil (*Lens culinaris*), and chickpea (*Cicer arietinum*).

Fruit trees

Remains of various fruit trees were encountered in the Tall Ḥisbān samples. These included walnut (*Juglans regia*), almond (*Prunus dulcis*), peach (*Prunus persica*), plum (*Prunus domestica*), fig (*Ficus carica*), grape (*Vitis vinifera*), and olive (*Olea europaea*). Partial or complete endocarps were found of walnut, almond, peach, plum, and olive; in stone fruits the endocarp is the hard shell that houses the seed and can preserve well under charring. Grape, fig, bramble, and olive seeds were found as well. Perhaps more surprising than the presence of these species is the absence of the seeds of date palm (*Phoenix dactylifera*), which has been found at other sites, such as Khirbat Fāris.¹¹³ It is interesting that it is also absent at Dhibān, and at Humayma, it is attested only in pre-Islamic contexts.¹¹⁴ Its large seeds preserve well and are easily recognizable, and finds are therefore ubiquitous, though generally in small numbers and not in large concentrations, on sites of all periods throughout the Levant and Egypt. This is because after they are consumed, their seeds are discarded, resulting in a scatter throughout the site. Its absence thus far is surprising and was also noted in an earlier archaeobotanical study of “Islamic period” contexts at Tall Ḥisbān.¹¹⁵ However, three date palm seeds were attested at Tall Ḥisbān in macro-botanical samples from unspecified pre-Islamic contexts, and evidence for date palm appears in the form of leaf phytoliths in Mamluk contexts.¹¹⁶ Therefore, the position of the date palm in the diet and agricultural economy at Mamluk Tall Ḥisbān in the Mamluk period, and Islamic periods more

¹¹² For instance, in the case of chickpea vs. lentil, see Cappers et al., “Barley Revisited.”

¹¹³ Hoppé, “A Thousand Years of Farming”; Hansen, “Evaluating archaeobotanical material from Khirbat Faris.”

¹¹⁴ See discussion for Dhibān in Farahani, “Sustaining Community under Empire,” and for Humayma in Megan Perry, Mahmoud Y. el-Najjar, Michael Finnegan, David S. Reese, and Jennifer Ramsey, “Human, Animal, and Plant Remains,” in John Peter Oleson and Robert Schick, *Humayma Excavation Project, 2: Nabataean Campground and Necropolis, Byzantine Churches, and Early Islamic Domestic Structures*, ed. Kevin M. McGeough (Boston, 2013), 321–80.

¹¹⁵ Gilliland, “Paleoethnobotany and Paleoenvironment.” It should be noted that in this paper, “Islamic period” is not specified to a particular period.

¹¹⁶ Crawford, LaBianca, and Stewart, “The Flootation Remains”; Gilliland, “Paleoethnobotany and Paleoenvironment.” It should be noted that there were only 3 date seeds present in the 1974 study of pre-Islamic contexts, and none were attested in any of the contexts studied by Gilliland, including Islamic contexts. See Laparidou, this article on the phytolith evidence.

generally, is not yet clear. More generally for Bilād al-Shām, however, it has been documented ethnographically that date seeds along with cereal straw and olive waste are animal fodder in the winter season besides being one of the foodstuffs in the local diet.¹¹⁷ The presence of palm trees as crops, especially the use of leaves for production of basketry, attested in written sources, may be gleaned through phytolith evidence, but will require further investigation.¹¹⁸ With respect to the few seeds of grape that were encountered, they might represent fruit for the table rather than winemaking, though wine presses are well attested at the site for earlier periods.¹¹⁹

Oil Crops

The only attested oil crop at Tall Ḥisbān thus far is the olive. While olives may be pickled and used as fruit for the table, they are also a common and important oil supplier and have been attested for the Mamluk period in Bilād al-Shām, both archaeologically and in written sources.¹²⁰ In the macro-botanical remains, there is evidence of whole and half olive endocarps (or olive stones), which indicate that they were consumed and then discarded; breakage in the endocarp is likely to have been caused during post-depositional processes. Simultaneously, there are many endocarps that have been broken into smaller fragments and seem to have been crushed, which would be caused by pressure of oil-pressing rather than table consumption;¹²¹ this evidence may point to olive oil production at the site.¹²² The waste of the olive-pressing, so-called pressing-cakes, were possibly used as fuel source in bread-ovens, as was still documented in the region by the early twentieth-century ethnographer Gustaf Dalman.¹²³ Another attested oil and fiber (see below) crop in the region is flax (*Linum usitatissimum*), of which the seed (often referred to as linseed) can be used to produce an oil; there is evidence of its

¹¹⁷ William Lancaster and Felicity Lancaster, *People, Land and Water in the Arab Middle East: Environments and Landscapes in the Bilād ash-Shām* (Amsterdam, 1999), 44.

¹¹⁸ See discussion in Walker, *Jordan in the Late Middle Ages*, 170; Laparidou, this article.

¹¹⁹ Project archives, Andrews University.

¹²⁰ Bethany J. Walker, "From Ceramics to Social Theory: Reflections on Mamluk Archaeology Today," *Mamlūk Studies Review* 14 (2010): 109–57.

¹²¹ Olive presses have been identified at the site, but they date to earlier (pre-Islamic) periods of occupation (project archives, Andrews University).

¹²² Cappers et al., "Barley Revisited." For further discussion of olive oil production, its by-products and their use, and preservation of those by-products in archaeological contexts, see Erica Rowan, "Olive Oil Pressing Waste as a Fuel Source in Antiquity," *American Journal of Archaeology* 119, no. 4 (2015): 465–82. For context, see Walker, *Jordan in the Late Middle Ages*, 189.

¹²³ Gustaf Dalman, *Arbeit und Sitte in Palästina*, vol. 4, *Brot, Öl und Wein*, 2nd ed. (Hildesheim, 1987), 17. Olive pressings or other waste could also be used as a fuel source in the winter as well, as documented by Lancaster and Lancaster, *People, Land and Water in the Arab Middle East*, 44.

presence in the Jordan Valley from the Iron Age period.¹²⁴ It is, however, absent at Tall Ḥisbān. Finds of oil crop seeds, however, are rare under charred preservation conditions, as the oil-rich seeds typically explode rather than char when exposed to fire. However, specimens of linseed have been found at Khirbat Fāris¹²⁵ and in Middle Islamic contexts at Tall Abu Sarbut¹²⁶ as well as from the Iron Age at Deir ʿAlla.¹²⁷

Fiber Crops and Sugar Cane

Fiber crops are used to make fabrics, rope, and basketry. Flax, in addition to being an oil crop (above), is used to produce linen and has been encountered at other sites in the region, but is absent at Tall Ḥisbān.¹²⁸ Regionally (Old World) cotton was a fiber crop of commercial importance,¹²⁹ but it also has not yet been encountered at this site. It is not clear if cultivation of fiber crops, therefore, was an important aspect of the agricultural economy in southern Bilād al-Shām, with the exception of the Jordan Valley and to a certain extent at Khirbat Fāris. This could indicate that local cultivation of fiber crops, and consequently the local textile industry, was tailored to local needs or exchange. It is clearer from written sources that the major cotton industry for the region was based in northern Bilād al-Shām, and there is evidence pointing to a European demand for “Levantine cotton.”¹³⁰ Perhaps the demands for textiles from southern Bilād al-Shām were met by supply from there or from imports from Persia or elsewhere.¹³¹ It could be worth investigating if this implies a preference for plant-based textiles in the region for this period.

¹²⁴ See E. B. Grootveld, *Het zaad der beschaving: Botanisch material van Tell Abu Sarbut nader bekeken* (Leiden, 2000); data in Eva Kaptijn, *Life on the Watershed: Reconstructing Subsistence in a steppe region using archaeological survey: a diachronic perspective on habitation in the Jordan Valley* (Leiden, 2009).

¹²⁵ A few samples of linseed attested in Hoppé, “A Thousand Years of Farming”; however, linseed was not attested in samples analysed by Hansen, “Evaluating archaeobotanical material from Khirbat Fāris.”

¹²⁶ Grootveld, “Archaeo-botanical Report of the Excavations of Tell Abu Sarbut.”

¹²⁷ See Grootveld, *Het zaad der beschaving*; data in Kaptijn, *Life on the Watershed*.

¹²⁸ Irrigated flax cultivation and the linen textile industry are well attested at Bronze Age and Iron Age sites in the Jordan Valley; see Kaptijn, *Life on the Watershed*, and Jeannette H. Boertien, “Unravelling the Threads: Textiles and Shrines in the Iron Age,” in *Sacred and Sweet*, ed. Steiner and van der Steen, 135–51. However, studies about flax cultivation in the Middle Islamic periods have not yet been published.

¹²⁹ It has been encountered at Mamluk Khirbat Fāris (Hoppé, “A Thousand Years of Farming”).

¹³⁰ See Maureen Fennell Mazzaoui, *The Italian Cotton Industry in the Later Middle Ages, 1100–1600* (Cambridge, 1981), and also Amalia Levanoni, *A Turning Point in Mamluk History: The Third Reign of al-Nāṣir Muḥammad Ibn Qalāwūn* (Leiden, 1995), for a discussion.

¹³¹ Hansen, “The Agricultural Economy of Islamic Jordan.”

Another important commercial crop of the region that has not been attested at Tall Ḥisbān is sugar cane (*Saccharum officinarum*). The reason for this absence may lie in the nature of the contexts that thus far have been excavated at the site for the Mamluk period. The archaeobotanical samples come from largely domestic contexts which, pertaining to plant materials, were likely mostly used for activities such as the storage, preparation, consumption, and disposal of food. More “industrial” activities related to the processing of sugar cane and fiber crops could have taken place in other areas.¹³² Another explanation for the absence of sugar cane may lie in Ḥisbān’s position within the Mamluk sugar trade. During this period, the production of sugar was concentrated in the Jordan Valley, the Ghor, where micro- and macrobotanical remains attest its presence.¹³³ As at the Mamluk sites of Faḥl,¹³⁴ Tall Abu Sarbut,¹³⁵ and Kerak Castle,¹³⁶ concentrations of sugar jars have been discovered at Tall Ḥisbān that would have been used to transport (semi-) refined sugar products (e.g., as a type of “sugary syrup”).¹³⁷ This may imply that the village was a consumer rather than a producer of sugar, and/or played a role in the distribution or “export” of sugar further afield (see further discussion below).

For both sugar, as well most fiber crops, the fact that not the seed but other plant tissues (for instance the culm) were processed and used may have reduced the chance of being preserved through charring. Products such as ropes, basketry, and textiles typically primarily survive through desiccation (such as at some Egyptian sites), but do not survive charring. Other plants that were not specifically cultivated as fiber crops could also supply fiber. An example are the

¹³² Surveys in the village’s hinterland, and along the region’s wadis, have identified only flour mills of the nineteenth century, however, and no medieval sugar mills, of the form familiar to the Jordan Valley (R. D. Ibach, *Hesban 5: Archaeological Survey of the Hesban Region: Catalogue of Sites and Characterization of Periods* (Berrien Springs, 1987).

¹³³ Laparidou and Rosen, “Intensification of production in Medieval Islamic Jordan,” 1685–97, and Hansen, “The Agricultural Economy of Islamic Jordan.”

¹³⁴ Stephen McPhillips and Alan Walmsley, “Faḥl during the Early Mamluk Period: Archaeological Perspectives,” *Mamlūk Studies Review* 11, no. 1 (2007): 119–56.

¹³⁵ H. E. LaGro, “Ayyubid–Mamluk Sugar Pottery from Tell Abu Sarbut, Jordan,” *Leiden Journal of Pottery Studies* 25 (2009): 63–102, and H. E. LaGro and H. de Haas, “Sugar Pots: a preliminary study of technological aspects of a class of medieval, industrial pottery from Tell Abu Sarbut, Jordan,” *Newsletter of the Department of Pottery Technology, Leiden* 7/8 (1989/1990): 7–20; 9/10 (1991/1992): 55–69.

¹³⁶ Marcus Milwright, *The Fortress of the Raven: Karak in the Middle Islamic Period (1100–1650)* (Leiden, 2008).

¹³⁷ Walker, *Jordan in the Late Middle Ages*, and Bethany J. Walker and Øystein S. LaBianca, “The Islamic Qusur of Tall Hisban: Preliminary Report on the 1998 and 2001 Seasons,” *Annual of the Department of Antiquities of Jordan* 47 (2003): 443–71.



Figure 13. Caper plant (*Capparis spinosa*) in front of the Salome Hotel, Madaba, Jordan. (Courtesy Annette Hansen)

leaves of the date palm (*Phoenix dactylifera*), which were widely used for basketry. Wicker-like materials could be made from wild grasses and reed (*Phragmites australis*—which was encountered at Tall Ḥisbān) and even cereal straw.

Vegetables and Condiments

Besides a potential find of caper seeds (*Capparis spinosa*), also found at Mamluk Khirbat Fāris, and some coriander seeds (*Coriandrum sativum*), also found at Mamluk Tall Abu Sarbut, no vegetable or condiment crops were encountered in the studied samples. Most certainly the inhabitants at Ḥisbān would have cultivated a variety of species that fit within these categories. Vegetables, as well as some condiments, are however underrepresented in charred assemblages as humans generally process and eat tissues that do not preserve as well as seeds; they eat for instance the bulbs (e.g., onion and garlic), roots (e.g., beet and carrot¹³⁸) or leaves (e.g., spinach and lettuce). Beet (*Beta vulgaris*) has been attested at Mamluk Tall Abu Sarbut.¹³⁹ Interpreting archaeobotanical finds of vegetables is difficult as many potential “vegetables,” including beet, may also occur as weeds that infest cereal fields and may not have been eaten (especially not as these are often underdeveloped or feral types). Similarly, various other potential vegetables, such as caper, can occur as ruderal plants in settlements (see Fig. 13).

¹³⁸ Al-Nuwayrī mentions many vegetables, including the carrot (*The Ultimate Ambition in the Arts of Erudition*, 183–92), though for the specified reasons of preservation, recovery in the archaeobotanical record can be difficult to impossible.

¹³⁹ Neef, “Plants,” and Grootveld, “Archaeo-botanical Report of the Excavations of Tell Abu Sarbut.”

Vegetable and herb cultivation tend to be ubiquitous both in past and present rural communities. While larger scale cultivation for the (local) market could have occurred, many households would have grown at least some of their vegetables in kitchen gardens or even on miniscule plots of only a few square meters.¹⁴⁰

Fodder Crops

In addition to grazing or browsing, the diet of domestic animals is often supplemented with fodder crops, which sometimes are actively cultivated for this purpose. Fodder crops have the advantage that fodder can be stored and used in part of the year during which areas suitable for grazing or browsing do not regenerate. Moreover, the amount of biomass obtained from an area where plants can grow undisturbed (such as the arable for fodder crops) is greater than grazing areas, since with grazing a lot of biomass is unproductively trampled. One fodder crop encountered in the Tall Ḥisbān assemblage was alfalfa (cf. *Medicago sativa*). Additionally, the pulse bitter vetch (*Vicia ervillia*) that was often used as a fodder crop, though it was suitable for human consumption, may have served in this capacity at Tall Ḥisbān. Crop-processing waste (also known as cereal by-products), such as threshing remains of cereals, likely also played an important role as a source of fodder. In his early twentieth-century ethnography, Gustaf Dalman made extensive note of this practice in the region.¹⁴¹ The use of grain kernels, in particular barley, as fodder for draught animals during times of intensive labour (e.g., ploughing oxen) is attested for many areas and periods and may also have occurred at Tall Ḥisbān, though grain kernels would first and foremost have been a human food.

Wild Plants

The study of wild plants within the macrobotanical samples has yielded several insights so far on the micro-environment of Mamluk Tall Ḥisbān. Firstly, all identifiable wild plant species encountered in the Tall Ḥisbān assemblage are typical for dry, temperate, or “Mediterranean,”¹⁴² climates and today still grow throughout Bilād al-Shām (see Table 1).

¹⁴⁰ Cappers and Neef, *Handbook of Plant Palaeoecology*.

¹⁴¹ Dalman, *Arbeit und Sitte in Palästina*, 4:15–17.

¹⁴² Many of the weed species belong to several “vegetations” (e.g., Omni-Mediterranean, East [sub-East] Mediterranean, South Mediterranean, Mediterranean and Irano-Turanian, East Mediterranean and Irano-Turanian, and Irano-Turanian), which are discussed in detail in M. Zohary, “The Segetal Plant Communities of Palestine,” *Vegetation* 2 (1950): 387–411. He mentions that the “local segetal flora owes its existence to migration processes rather than to introduction (intentional or unintentional) by man” and that for many species it is difficult to determine whether these plants originated within the segetal habitat or in their primary habitats that were “later conquered by agriculture” (387–88). Since Zohary’s study there have been additions made in the species known for each vegetation.

Secondly, the wild grasses encountered are typical examples of species that can be invasive of cereal fields. These species are drooping brome (*Bromus tectorum*), wild barley (*Hordeum vulgare* ssp. *spontaneum*), darnel (*Lolium temulentum*), and canary grass (*Phalaris* sp.). The morphology of the growing plants for darnel, also known as the poison darnel because of its toxicity to humans, is particularly difficult to differentiate from wheat plants. Its seeds, to the untrained eye, closely resemble domesticated barley seeds.¹⁴³ The presence of these wild grasses, particularly *Phalaris* sp. and *Hordeum vulgare* ssp. *spontaneum*, in cereal fields is not new. Evidence from Jordan from the Neolithic onwards has shown they are very much a part of the “cereal growing culture” in Bilād al-Shām.¹⁴⁴

The presence of these species in the form of charred seeds is noted at Tall Ḥisbān, as well as all other archaeobotanical studies, in Bilād al-Shām in the medieval and late medieval periods, including at Khirbat Fāris and Dhibān. Evidence for wild grasses has also been encountered in the phytolith assemblage.¹⁴⁵

Today, canary grass, particularly *Phalaris minor*, still is a pest that forms a “constraint” on the productivity of wheat fields worldwide, for example, in contemporary India¹⁴⁶ and Morocco,¹⁴⁷ though they mention *Phalaris* spp.¹⁴⁸ and *Bromus rigidus* explicitly. *Phalaris paradoxa* and *Phalaris minor* are mentioned as pests and

¹⁴³ Mark Nesbitt, *Identification Guide for Near Eastern Grass Seeds* (London, 2006).

¹⁴⁴ Chantel E. White and Cheryl A. Makerewicz, “Harvesting practices and early Neolithic barley cultivation at el-Hemmeh, Jordan,” *Vegetation History and Archaeobotany* 21 (2012): 85–94; *Phalaris paradoxa* and *Lolium temulentum* have also been found in assemblages in Predynastic Maadi (Egypt); also linking them to the Neolithic revolution in Egypt, see Ahmed Gamal-El-Din Fahmy, “Review Insights on Development of Archaeobotanical and Palaeo-ethnobotanical Studies in Egypt,” in *Egypt at its Origins: Studies in Memory of Barbara Adams: Proceedings of the International Conference “Origin of the State: Predynastic and Early Dynastic Egypt,” Krakow, 28th August–1st September 2002*, ed. S. Hendrickx, R. F. Friedman, K. M. Cialowicz, and M. Chlodnicki (Leuven, 2004), 723.

¹⁴⁵ See Laparidou, this article.

¹⁴⁶ R. S. Chhokar, R. K. Sharma, and I. Sharma, “Weed management strategies in wheat—A review,” *Journal of Wheat Research* 4, no. 2 (2012): 1–21, and R. Chatrath, B. Mishra, and J. Shoran, “Yield Potential Survey—India,” in *International Symposium on Wheat Yield Potential: Challenges to International Wheat Breeding*, ed. M. P. Reynolds, J. Pietragalla, and H. J. Braun, (Mexico, 2008), 49–53.

¹⁴⁷ R. Dahan, M. Jlibene, and N. Nasrallah, “Challenges to Wheat Production in Morocco,” in *International Symposium on Wheat Yield Potential*, 70–73.

¹⁴⁸ Spp. is an acronym for *Species pluralis*, meaning multiple species. When this term is applied, it is meant to apply to all species within the genus being discussed.

constraints on barley yields by Burleigh et al.¹⁴⁹ and for Nepal,¹⁵⁰ whereas *Bromus* sp. and *Hordeum vulgare* ssp. *spontaneum* are similar constraints in Iran.¹⁵¹ *Bromus* spp. are listed as constraints in Turkey.¹⁵² Separating these species from the grain product is not always deemed efficient, and the wild plants, or potential crops that may occur as “weeds” (e.g., bitter vetch) on arable fields, always make up a percentage of this product.¹⁵³ Common reed (*Phragmites australis*), which has been attested in the macrobotanical evidence in the form of carbonised (fragmented and complete) culm nodes, is found frequently at the edges of arable fields, for instance in drainage ditches and irrigation canals.

Thirdly, of the other wild plants identified so far, they also become mature and produce seeds in the winter season, which also corresponds to the time of the cereal harvest and are likely all segetal plants. In an earlier study, some of the species, including *Lolium temulentum*, *Hordeum* spp. (weed species), *Bromus* spp., *Silene* spp., *Malva* spp., *Galium* spp., *Phalaris* spp., *Alkanna* spp., and *Teucrium* spp. have been associated with cereal fields in Palestine.¹⁵⁴ While these may have been collected accidentally with the arable crop during the harvest and ended up on the threshing floor, others may be deliberately collected and used as extra “brush-fuel” during cooking or bread-baking. Dalman makes specific reference to the use of wild species as fuel in rural villages in Palestine and Jordan in the early twentieth century.¹⁵⁵ When community baking is the standard, each baker using the oven must provide her own fuel,¹⁵⁶ which beyond wild plants would have consisted of olive pressings, processing waste from cereal cultivation, or dung.

Fourthly, some fodder crops like alfalfa can also be winter crops. For example, cf. *Medicago sativa* can be grown in the springtime or the late summer, thus maturing (fruiting) and seeding either in the late summer or winter. *Ajuga* / *Teucrium* sp., especially when preserved in a carbonised state, are very difficult to identify to a lower taxonomic level; however, these too are likely to have been plants that

¹⁴⁹ J. R. Burleigh, M. Tajani, and M. Seck, “Effects of *Pyrenophora teres* and Weeds on Barley Yield and Yield Components,” *Phytopathology* 78, no. 3 (1988): 295–99.

¹⁵⁰ M. R. Bhatta, R. C. Sharma, and G. Ortiz-Ferrara, “Challenges to Wheat Production in Nepal,” in *International Symposium on Wheat Yield Potential*, 74–78.

¹⁵¹ M. R. Jalal Kamali and E. Duveiller, “Wheat Production and Research in Iran: A Success Story,” in *International Symposium on Wheat Yield Potential*, 54–58.

¹⁵² Ü. Küçüközdemir, T. Yildirim, S. Taner, A. Yilmaz, R. Ünsal, N. Bolat, M. Kalayci, E. Dönmez, S. Yazar, N. Zencirci, I. Özseven, I. Öztürk, A. K. Avçin, N. Dinçer, E. Kün, B. Akin, S. Karahan, H. Kiliç, A. Ilkhan, Turkish Ministry of Agriculture and Rural Affairs, General Directorate of Agricultural Research, “Wheat in Turkey,” in *International Symposium on Wheat Yield Potential*, 91–94.

¹⁵³ See Heinrich, “Modelling Crop-Selection in Roman Italy,” for a discussion on this topic.

¹⁵⁴ Zohary, “The Segetal Plant Communities of Palestine.”

¹⁵⁵ Dalman, *Arbeit und Sitte in Palästina*, 4:12–15.

¹⁵⁶ *Ibid.*, 76.

matured in the winter season. *Celtis australis* can bear fruit from the fall into the winter months, which makes it possible for seeds to be discarded alongside the other winter weeds in the assemblage. Where wild plants have only been identified to the family level, such as *Brassicaceae*, it should be noted that there are several plants within this family that grow alongside or near arable fields that can be (unintentionally) collected with cereal crops during the harvest, and thus end up in the archaeobotanical assemblage

A faunal narrative

The investigation of everyday life, through the analysis of animal remains, provides a deeper understanding of the exploitation and management of local resources during the Mamluk period. In these assemblages from Tall Ḥisbān, domestic and wild species were identified at both the citadel and the village (Table 2). The list of taxa shows a larger variety of wild species in the citadel, corresponding to 8% of the total NISP. In the village it is only 3% of the NISP.

Environmental Indicators

Animal remains, and in particular wild species, play a relevant role in the reconstruction of past environments, as some of them can be very sensitive indicators of change.

Both the analyzed samples show wild taxa that can be mainly associated with a semi-arid environment. A considerable exception is represented by the presence of roe deer among the remains from the citadel. This species usually lives in woods and occasionally in grasslands and sparse forests. The ancient distribution of roe deer in the Levant was drastically reduced in recent times, partially due to a combination of hunting pressure and progressive deforestation of its natural habitat. At the present, roe deer are extinct in Jordan, although in the 1980s some individuals from Turkey were introduced in the western highlands of the country, north of Ajlun.¹⁵⁷ Current environmental conditions in the surroundings of Tall Ḥisbān are not suitable for the roe deer, but probably during the Middle Ages woodlands extended south of Ajlun, which is located about one hundred kilometers from the site. The scarcity of roe deer remains in the sample indicates that this species was not available near Ḥisbān, but it was probably hunted in the territories north of the site and then traded as a high-status product.

Fallow deer remains are also rare and recovered only in the assemblage from the citadel. This species prefers open woodlands and grasslands. It was not pos-

¹⁵⁷ Marco Masseti, "Note on the Near-Eastern relic population of roe deer, *Capreolus capreolus* (L., 1758), (Mammalia, Artiodactyla)," *Biogeografia dell'Anatolia* 21 (2000): 619–24. The author (Corbino) is grateful to Marco Masseti for the interesting discussions about the past distribution of roe deer in Jordan.

Table 2: NISP (Number of Identified Specimens) and MNI (Minimum Number of Individuals) frequencies of taxa for the two areas investigate

Taxa	Citadel		Village	
	NISP	MNI	NISP	MNI
Dromedary	1	1		
Horse	2	1	2	2
Donkey	1	1	2	1
Pig/Wild Boar			5	3
Cattle	12	2	5	3
Sheep/Goats	963	28	87	12
Sheep	22	11		
Goats	33	9	2	1
Gazelle	60	7	1	1
Roe Deer	1	1		
Fallow Deer	2	2		
Nubian Ibex	2	2	1	1
Ibex/Bezoar	16	3		
Dog	9	2		
Cat	1	1	1	1
Fox	9	2		
Sand Fox	1	1		
Honey Badger	1	1		
Cape Hare	2	1		
Chicken	401	35	16	6
Chukar	2	1		
Goose	14	2		
Swan	2	1		
Pigeon	3	1		
Eurasian Thick-knee	2	1		
Macqueen's Bustard	1	1		
Barn Swallow			1	1
<i>Emberiza</i> sp.			1	1
Parrotfish	3		7	
TOTAL	1566		131	

sible to identify the sub-species; however, it suggests the existence of a humid and green environment, probably some kilometers north of Ḥisbān. The occurrence of this species has similar implications to that of roe deer remains, and probably played an analogous economic and social role at Tall Ḥisbān in the Mamluk period.

The majority of the identified wild species (in particular: gazelle, ibex, foxes, honey badger, and cape hare) indicates a semi-arid environment similar to that which characterizes the region today. The gazelle occurs in both areas, although in the citadel it is the second most abundant mammal. Nowadays the gazelle survives only as remnant populations in protected areas of the Near East; however, they used to be more widespread in the past and have been hunted since Prehistory. Three species lived in Jordan in the past: *Gazella dorcas*, *Gazella subgutturosa*, and *Gazella gazella*.¹⁵⁸ Currently, it is not possible to distinguish these three species on the basis of bone and teeth morphological criteria; therefore, the remains identified in the Ḥisbān assemblage were generically attributed to the genus *Gazella*. The large size range of the gazelle bones observed at Ḥisbān suggests the occurrence of more than one species. The high frequencies of gazelles in the archaeological assemblages attest that they were largely available in the vicinity of the settlement at that time; in the late nineteenth to early twentieth centuries, indiscriminate hunting and rapid habitat loss had a major impact on the distribution of the three species of gazelle in southwest Asia,¹⁵⁹ causing the drastic reduction of the number of individuals.

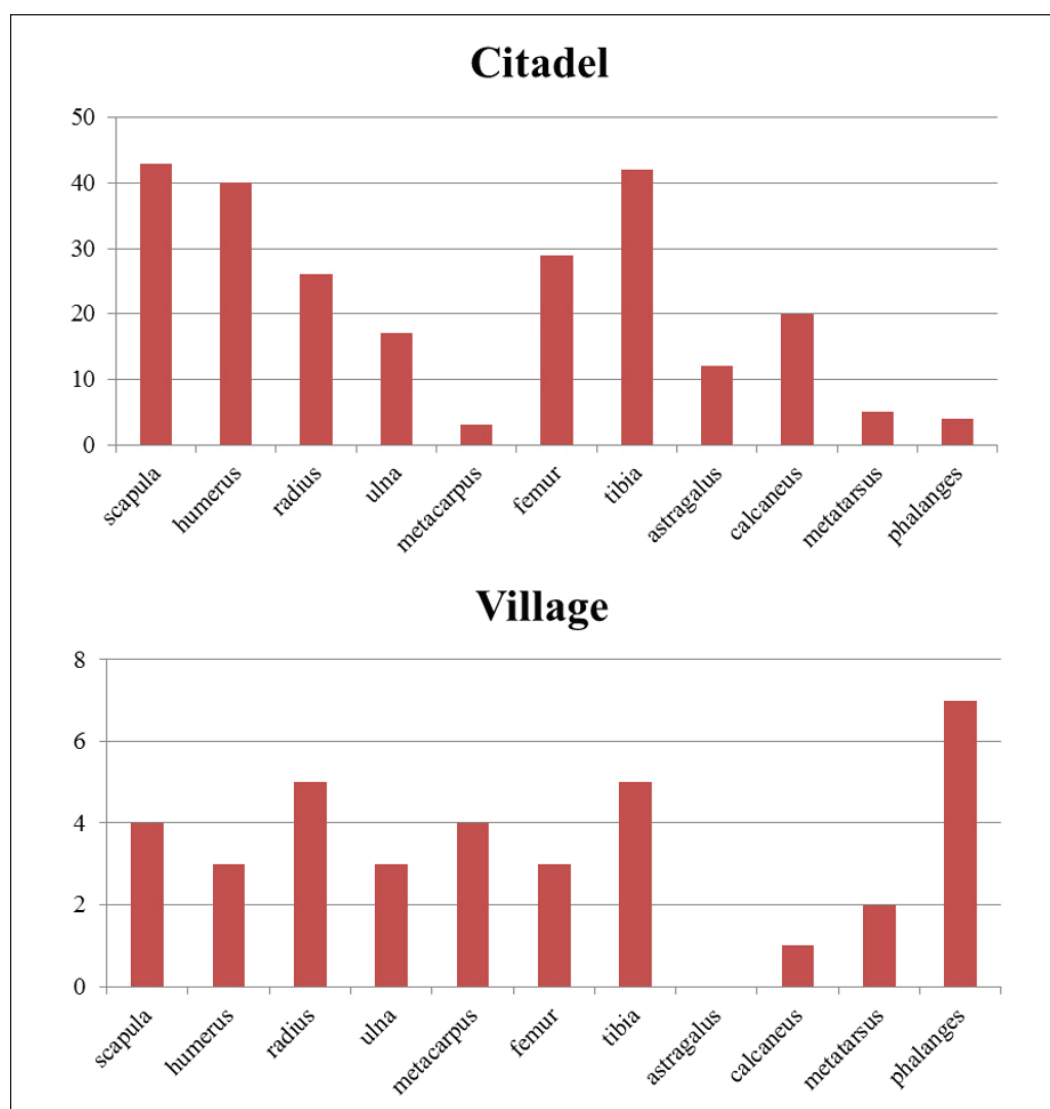
Remains of ibex have been collected in both the citadel and village areas. They probably belong to the Nubian ibex sub-species (*Capra nubiana*, Cuvier, 1825), which live in rough dry mountainous terrains. In Jordan, this ungulate is still present on the remote hill slopes of the Rift Valley, Dead Sea (e.g., Wadi Mujib), and in the arid southern desert.¹⁶⁰ The occurrence of ibex attests the exploitation of a large territory in the site surroundings that extended to the nearest mountain ranges.

The frequency of domestic species is influenced by human choices and preferences. However, the local environment contributes to the selection of the species raised at a site. Bone assemblages from fourteenth-century Mamluk contexts in southern Jordan show a slight increase in goat frequencies compared to sheep in

¹⁵⁸ Marco Masseti, "Fauna of southern Jordan: Notes on 22 endangered or extinct mammal and bird species," *Studi per l'Ecologia del Quaternario* 12 (1990): 133–46.

¹⁵⁹ Guy Bar-Oz, Melinda Zeder, and Frank Hole, "Role of mass-kill hunting strategies in the extirpation of Persian gazelle (*Gazella subgutturosa*) in the northern Levant," *Proceedings of the National Academy of Science* 108, no. 18 (2011): 7345–50.

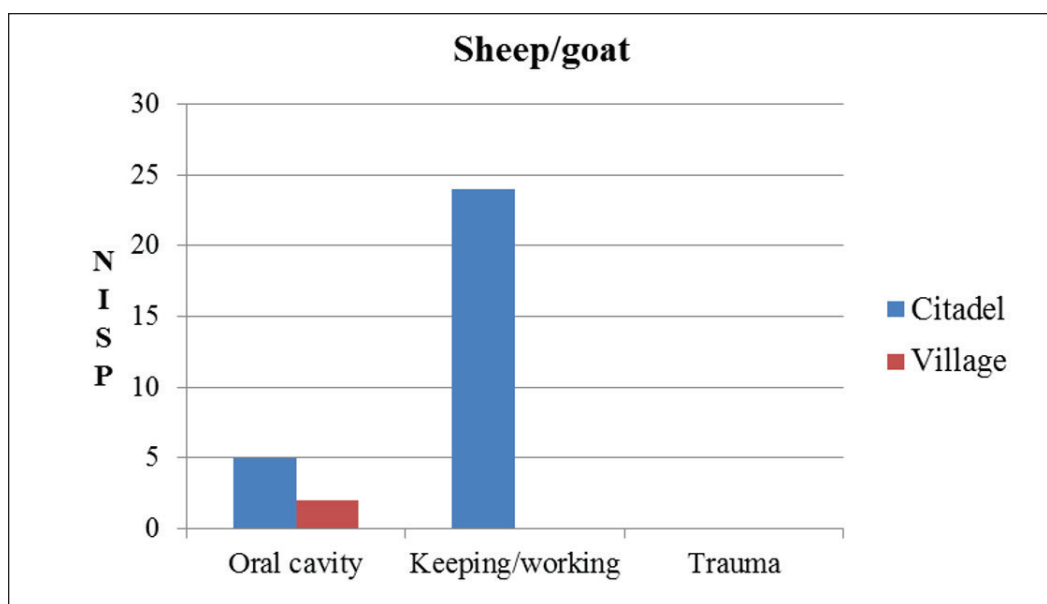
¹⁶⁰ Masseti, "Fauna of southern Jordan."



Graph 2. Anatomical frequencies of sheep/goat based on MNE for the two areas investigated.

terms of NISP.¹⁶¹ Goat is more adaptable than sheep to semi-arid environments. It requires grass for grazing, but can live in areas of thin growth that would not support other grazers such as sheep or cows; it could be also kept in very dry

¹⁶¹ Robin Brown, "The faunal distribution from the Southern Highlands of Transjordan: Regional and Historical Perspective on the Representative and Roles of Animals in the Middle Islamic Period," in *Landscape of the Islamic World: Archaeology, History and Ethnography*, ed. Stephen McPhillips and Paul D. Wordsworth (Philadelphia, 2016), 71–93.



Graph 3. Pathological evidence for sheep/goat based on NISP.

environments if constantly fed by humans.¹⁶² The sheep/goat proportion of NISP in the Ḥisbān assemblage appears in line with the general trend of the Mamluk period. The apparent increase in the incidence of this taxon could be indicative of a change, in environmental conditions or in human subsistence strategies.

Space Management

The distribution of the anatomical elements of sheep/goat based on MNE (Graph 2) shows higher frequencies of meat-bearing bones and high-quality cuts in the assemblage from the citadel. In this area, anatomical elements usually associated with primary butchery, such as phalanges, are rare. On the other hand, the small assemblage collected in the village displays a good number of phalanges and tarsal bones besides meat-bearing bones.

Bones from the lower limb do not provide much meat; therefore, they are usually discarded during the butchery process. High frequencies of these anatomical parts could indicate primary carcass processing rather than consumption. The comparison between the analyzed archaeological contexts suggests that sheep/goat were preferentially slaughtered outside the citadel, probably in the village, and then taken to the citadel already divided in portions.

The abundant remains of gazelle from the citadel show a good representation of all anatomical elements. Carcasses of this small ungulate were probably

¹⁶² José R. Castelló, *Bovids of the World: Antelopes, Gazelles, Cattle, Goats, Sheep, and Relatives* (Princeton, 2016).

processed directly at the citadel. Furthermore, due to its economic value, perhaps only a few anatomical parts were discarded before consumption.

Spatial organization can be investigated also through the study of the pathological evidence. Domestic animals can be affected by different types of pathologies related to husbandry practices.

In the citadel, pathologies resulting from keeping/working are the most abundant (Graph 3). The absence of this evidence in the remains from the village could be related to the small sample size or to specific differing management choices. On a speculative basis, it is possible to hypothesize that the animals consumed at the citadel were bred in larger flocks outside the settlement and under intensive husbandry practices that would have caused a higher incidence of pathologies related to keeping/working. On the other hand, the inhabitants of the village would have relied on small flocks of a few individuals, probably kept in the village.

Diet

Was There a Village Cuisine?

Rarely do we read in Mamluk-era sources what rural peoples ate. We do not know much, either, about the daily diet of soldiers stationed in garrisons. We have rich documentation, however, of the diet and cooking culture of Cairo and Damascus.¹⁶³ The autobiographical account of Ibn Ṭawq has increasingly attracted attention for its detailed descriptions of food. The author, who had to be careful with his own household budget, relished his many meals as a guest at the homes of other scholars in Damascus at the turn of the sixteenth century. He described an urban cuisine that centered on meat (lamb was the most expensive), bread (socially ranked on the basis of the grain type), and milk products. Rice became a key component of the diet. Fish played a marginal role in that cuisine, and vegetables appear only as complements to meat dishes.¹⁶⁴

How different from this the rural diet must have been, and how great the regional variations. The diet of Ḥisbānīs was, unsurprisingly, bread-heavy: the site is covered with bread ovens (*ṭabūn*/pl. *ṭawābīn*), which can be found in every household, in the citadel kitchen, and in what appear to be public buildings for communal-baking of bread.¹⁶⁵ Both wheat and barley in their many varieties

¹⁶³ Amalia Levanoni, "Food and Cooking during the Mamluk Era: Social and Political Implications," *Mamlūk Studies Review* 9, no. 2 (2005): 201–22; Paulina B. Lewicka, *Food and Foodways of Medieval Cairenes: Aspects of Life in an Islamic Metropolis of the Eastern Mediterranean* (Leiden, 2011); Torsten Wollina, *Zwanzig Jahre Alltag: Lebens-, Welt- und Selbstbild im Journal des Ahmad Ibn Ṭawq* (Bonn, 2014), 156–70.

¹⁶⁴ Wollina, *Zwanzig Jahre Alltag*.

¹⁶⁵ Hansen, Walker, and Heinrich, "'Impressions' of the Mamluk agricultural economy."

were consumed not only in the form of bread, but also as (and alongside) other foodstuffs. The by-product of cereal processing, both from wheat and barley, along with barley kernels, bitter vetch, and other weeds would have also been used as animal fodder. Despite its perception as being less desirable as a foodstuff in urban consumption, barley was a staple for inhabitants of rural sites. But the faunal record also attests to a diversified meat diet, with a preference for sheep and goat, in addition to chicken, wild game, and fish. For most anatomical parts, the skeletal remains of sheep cannot be differentiated from goats. In the village the only remains identified at the species level belong to goat, though sheep and goat were consumed in both the citadel and village. Most of the meat was probably supplied by the village itself; the domestic animals, and in particular sheep and goats, were butchered in the village,¹⁶⁶ and the meat distributed on an unequal basis within the settlement, with the best cuts of meat being sent to the citadel. However, the needs of the citadel, which was an extra burden on the village in the fourteenth century, may have necessitated going beyond the ability of the local community to “feed the garrison.” Local Arab and Turcoman tribesmen supplied the city of Damascus with meat and milk products, and Syrian “Bedu” regularly supplied the Mamluk army with sheep.¹⁶⁷ It is possible that the Banū Maḥdī of the Madaba Plains, who maintained a very close relationship with the village, the local governor, and the sultans al-Nāṣir Muḥammad and Barqūq, did the same.¹⁶⁸ They may have also been the source of the wild game consumed by the garrison, if the soldiers were not hunting game on the Madaba Plains and the forests to the north for themselves.¹⁶⁹

Cooking pots are among the best artifacts for reconstructing cooking culture and diet. One kind of cooking pot dominates the assemblage of the Mamluk levels

¹⁶⁶ The association of lithic tools with animal bones in farmhouse deposits suggests that meat processing was largely done in the village and may have been done, to some degree, with stone tools. A use-wear analysis of the stone tools (an archaeological method to identify tool function through examination of their working surfaces and edges) to compare to the cutting patterns on the bones is underway. The same tools will be subjected in the future to residue analysis and phytolith sampling, in order to determine whether they were also used for processing of cereals and vegetables.

¹⁶⁷ Wollina, *Zwanzig Jahre Alltag*, 160; Taqī al-Dīn Ibn Qāḍī Shuhbah, *Tārīkh Ibn Qāḍī Shuhbah*, ed. ‘Adnān Darwīsh (Damascus, 1997), 4:397.

¹⁶⁸ Walker, *Jordan in the Late Middle Ages*, 124ff; idem, “The Tribal Dimension in Mamluk-Jordanian Relations,” *Mamlūk Studies Review* 13, no. 1 (2009): 82–105.

¹⁶⁹ Notably, the remains of wild game (ostrich, gazelle) were also recovered from houses of the Mamluk-era village, excavated in the 1970s (Thomas S. Parker, “Tell Hesban 1976: Area C.4, 6,8,9, 10,” *Andrews University Seminary Studies* 16 [1978]: 71–108). Either hunting game was not necessarily a Mamluk privilege (or it was not enforced), or wild game was available to all, perhaps provided by local pastoral nomadic tribes.

at Tall Ḥisbān: a deep, globular form, covered in a burnished red slip. The popular name for the ware refers to the shape of the handle: “elephant-eared cook pots.” They have a long history in rural Bilād al-Shām, spanning the thirteenth–early twentieth centuries. Their appearance in the thirteenth century (when frying pans disappear) may be associated with changes in diet, cooking, and dining culture after the Crusader interlude. Changes in cooking pots can be related to changes in diet (perhaps a deep, globular bowl for a stew with greater meat content or for serving), food preparation traditions (a different shaped handle might reflect changes in cooking time, globular forms are best suited for boiling food), or dining culture (family members eating from the same bowl). Without residue analysis (discussed below), one cannot be sure what was cooked in these vessels, but they are ideally suited to the slow boiling of meat and may have been used in the preparation of lamb stews, as described in Ibn Ṭawq’s account. Mutton was an important part of the diet in Transjordan in this period, as it is in modern Jordan. The national dish (*mansaf*)—boiled lamb and goat piled on rice served in a yogurt sauce—is described in narrative accounts about Transjordanian tribes in the fourteenth century.¹⁷⁰

Previous archaeozoological research at Tall Ḥisbān¹⁷¹ indicates that unlike Damascus, fish appears to have been a considerable element in the diets of people living at Ḥisbān. The fish-based diet was, moreover, rather diverse, being supplied by both the Red Sea (parrot fish and grey mullet, possibly through a Christian network based in the Sinai) and Mediterranean (drums/croakers, likely in dried form). Such a “delocalized diet” also characterizes that of the fortified settlements at Shobak and Karak.¹⁷²

The local diet beyond cereals and meat is more difficult to reconstruct. Vegetables are not readily identifiable archaeologically, the result of poor preservation of vegetable matter in the archaeobotanical record (the soft tissues of plants are consumed).¹⁷³ Vegetables appear in sixteenth-century tax registers under the category of “summer crops” (*māl sayfī*), but there was no attempt by the tax authorities to distinguish specific crops within that category. Scattered references to specific fruits and nuts cultivated in Ḥisbān do appear in Mamluk- and Otto-

¹⁷⁰ The *mansaf* is the national dish of Jordan: rice and boiled lamb (or sheep and goat) served in a heavy yogurt sauce on a large tray. It is often mentioned in Mamluk-period sources in the context of entertaining by and for tribal shaykhs and amirs.

¹⁷¹ LaBianca and von den Driesch, *Hesban 13: Faunal Remains*.

¹⁷² Walker, *Jordan in the Late Middle Ages*, 177–78.

¹⁷³ One archaeological method for identifying vegetable traces is organic residue analysis, through which vegetable proteins are recovered from artifacts (like cooking and storage pots, basketry, and mortars and pestles). We have only begun to apply this method in the excavations, as we have only now reached stratigraphically meaningful levels in the medieval farmhouses.

man-era sources. According to Ibn Qāḍī Shuhbah, a flood in 787/1385 destroyed 18 gardens (devoted to what crops, we do not know) and 1200 walnut trees.¹⁷⁴ Ibn Ḥijjī makes regular reference to the general concern that the vegetable crops would fail because of unseasonable cold and rain.¹⁷⁵ By 1538, the only commodities taxed by the new Ottoman authorities at the village of Ḥisbān were olive oil and grapes.¹⁷⁶ What role they played in the local economy, however, cannot be determined on these sources alone. A list of fruit and nut seeds recovered from the site appears below.

As for the rice, which was such an important component of the Damascene diet in the fourteenth and fifteenth centuries, we can say little for this site. The morphology of rice cannot be distinguished from other cereals, and cannot be identified as such in the archaeobotanical record. There is, as well, no known textual reference, to date, of cultivation or consumption of rice at Ḥisbān in this period.

A couple of important trends emerge from this survey of local diet. First, that what we think we know about urban diet cannot be applied to rural ones. Moreover, there are considerable regional differences in Bilād al-Shām in food production and consumption, with local production and economic and social ties to production centers being important factors in provisioning a settlement. The second trend has to do with the spatial distribution of food (in plant and animal form) throughout the site. While the diets of the soldiers stationed in the Ḥisbān citadel and the residents of the village overlapped to a large degree, meat consumption in the citadel reveals that the soldiers had access to the best cuts of meat and to wild game.¹⁷⁷ We are only beginning to understand the mechanisms of food (and water) distribution at the site, and this will remain a focus of archaeological research in the future.

¹⁷⁴ Ibn Qāḍī Shuhbah, *Tārīkh*, 4:157.

¹⁷⁵ The references are scattered throughout his chronicles and are too numerous to mention here, but to cite a single one, see Ibn Ḥijjī, *Tārīkh*, 3:776. In this entry, the chronicler specifies that what threatened the crops was a sudden drop in temperatures and heavy rains, after a spell of hot, dry weather.

¹⁷⁶ *The Detailed Defter of Liwa' 'Ajlūn (The District of Ajlun) Tapu Defteri No. 970*, ed. Muḥammad 'Adnān al-Bakhīt and Noufān Raja Ḥmoud (Amman, 1989), 30. Olive and grape seeds were retrieved from Mamluk-era contexts at the site during the excavations in the 1970s (LaBianca, *Sedentarization*, 231).

¹⁷⁷ Comparison of the material culture in the citadel and farmhouses reveals the same patterns: similar consumption of the same assemblages of local and imported ceramics and glass, and even collaboration in water use and maintenance of water facilities (Walker, "Planned Villages"). The "special relationship" between citadel and village still needs to be explained.

Food Remains at Tall Ḥisbān

Phytoliths

According to the phytolith records, a cereal-based diet was followed at Tall Ḥisbān. Phytolith evidence derived from the citadel and the farmhouses in the village indicated that cereal production and management of cereal grain, cereal by-products, and livestock played an important role in local diet. The phytolith records picked up the use and storage of wheat and barley based on the cereal husks found in all Fields sampled, including the citadel midden (Square M1), the vaulted building (Square M8) and the farmhouse (Square O9) (Figs. 1a and b). Large amounts of wheat husk phytoliths, and smaller amounts of barley husk phytoliths, were found in smaller amounts in Square M8. Square M1 was rich in wheat husk phytoliths, although these are present in slightly lower amounts than in Square M8. On the contrary, barley husk phytoliths are present in higher amounts in the fill layers of Square M1, compared to Square M8 (Fig. 1b). Barley husk phytoliths are present in all of the samples derived from the two fill layers in Square M1, while wheat husk phytoliths are absent from one sample. Also, high densities of identified wheat and barley husks and lower relative absolute counts of wild grass husks inside the barrel-vaulted structure (Square M8) indicated the deposition, processing, and/or storage of clean cereal crop in this context. The phytolith records picked up the use and storage of date palms too, which were present in sediment samples derived from the citadel and from the farmhouse (Square O9), showing that dates (*Phoenix dactylifera*) were also locally consumed. The date palms were likely grown in the Jordan Valley and the dates transported to the village of Ḥisbān.

Macrobotanical Remains

From the archaeobotanical assemblage from Tall Ḥisbān, cereals were the dominant staple followed by pulses. Cereals and pulses were consumed in a variety of forms—bread, porridge, gruel, barley-water, stews—and the two categories were often combined in producing flours and dishes. Barley and pulse porridges are even recommended in health remedies to balance the humors.¹⁷⁸ In the scholarly tradition on ancient and medieval diets, there is a negative assessment of such a staple-based diet.¹⁷⁹ However, new studies are bringing to light that the variety of staple crops that were accessible to farming communities like at Ḥisbān could have met the daily requirements of macro- and micronutrients and amino acids.¹⁸⁰

¹⁷⁸ Al-Nuwayrī, *The Ultimate Ambition in the Arts of Erudition*, 184.

¹⁷⁹ Peter Garnsey, *Food and Society in Classical Antiquity* (Cambridge, 1999).

¹⁸⁰ See A. M. Hansen and F. B. J. Heinrich, “Pulses,” in *Diet and Nutrition in the Roman World*, ed. P. Erdkamp and C. Holleran (London, in press), and F. B. J. Heinrich, “Cereals,” in *ibid*.

These staples were supplemented by olive oil, fruits and nuts for the table, milk, cheese, and varying amounts and qualities of meat. This well-rounded diet is also attested at other contemporary village sites such as Khirbat Fāris and Dhibān.

Animal bones

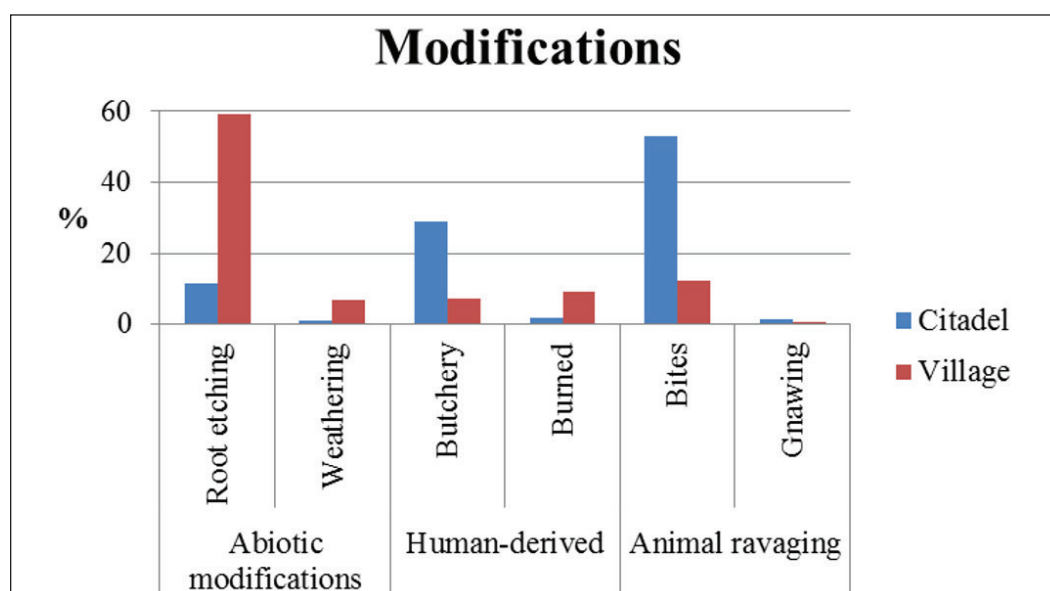
The meat diet of the inhabitants of Ḥisbān relied mainly on sheep/goat and chicken during the Mamluk period. Wild birds and mammals contributed to a lesser extent to the meat intake. They were mainly consumed in the citadel and only occasionally in the village. Although fish occurs in small quantities in both areas, it indicates a really varied food regime. Remains of pig were identified in the village assemblage only. It is likely that a small Christian community lived in the village during the Mamluk period.¹⁸¹ Indeed, Madaba, a city in Jordan well known for the presence of a large Christian community, is located a few kilometers away from Ḥisbān. The assemblage from the citadel did not present any remains of swine; this area was occupied by Mamluk soldiers, who may have maintained a Muslim diet.

The variety of domestic and wild species, the frequencies of anatomical parts, and kill-off patterns indicate high-quality meat consumption in the citadel. Sheep/goat and cattle remains are represented by the best cuts. Most sheep/goats were slaughtered by the second year of life and several of them within the first year. Only a few individuals reached adulthood. Teeth frequencies highlight the abundance of the fourth deciduous lower premolar in the citadel sample, while the most numerous teeth in the village are fully-formed third permanent lower molars. This could indicate the prevalent consumption of adult individuals in the village, where animals would have been exploited for secondary products for longer, and the preference for juveniles in the citadel. The consumption of young sheep and goat is typically shown as a “luxury” but in some poetry/stories, their meat is associated with gluttony as well;¹⁸² however, these two concepts are not often separate from each other.

A relatively wide range of modifications was identified in the analyzed sample, which include root etching, weathering, butchery marks, combustion features, bites, and gnawing (Graph 4). In the citadel cut marks can be associated to the

¹⁸¹ A group burial of the fourteenth century in the northern church (which was then in ruins) is suggestive of funerary practices of Orthodox Christians in contemporary Cyprus. See Bethany J. Walker, “Islamization of central Jordan in the 7th–9th centuries: lessons learned from Tall Hisban,” *Jerusalem Studies in Arabic and Islam* 40 (2013): 143–75.

¹⁸² For reference to its association with gluttony see: “A Day in the Life of Abū al-Qāsim” by Abū al-Mutahhar al-Zādī (eleventh century) (Geert Jan van Gelder, *Of Dishes and Discourse: Classical Arabic Literary Representations of Food* [Richmond, 2000], 74–79), and a satirical poem by Abū ‘Abd Allāh al-Bunānī (ninth century), discussed by van Gelder, *ibid.*, 85–86.



Graph 4. Relative frequencies of post-mortem modifications for the two areas investigated.

work of experienced butchers. There is evidence of the use of a heavy blade, possibly an axe. The vertebrae are largely chopped in half sagittally, while the ribs are chopped transversally. The few striae denote possible defleshing before cooking. Only little butchery evidence was identified in the village assemblage, due to the small size of the sample.¹⁸³

Burned fragments are very rare in the citadel, while they are proportionally abundant in the village. Although there are some limitations due to differences in the dimensions of the samples, it is possible that different cooking methods were adopted in the two investigated areas. Indeed, the coriaceous meat of older individuals, such as those identified in the village assemblage, requires multiple cooking steps to become edible.

Indicators of social differences in diet, highlighted in the analyzed assemblages, provided evidence for differences in diet between the two social strata at Tall Ḥisbān: the local population (the residents of the village—a mixed population which must have included *fallāḥīn*, scholars, and merchants)—and mamluks (soldiers and officers stationed in the citadel). It seems that the inhabitants of the citadel had a much more varied and higher-quality meat diet compared to the villagers, although the assemblage from the village is quite small.

¹⁸³ See notes above for the study of butchery in the village.

Economy

Food Markets

Clearly grain cultivation dominated agricultural production in the village of Ḥisbān in the fourteenth century. While the textual record suggests that this production was, at least in part, market-driven, the choice for hard wheat as the preferred wheat over emmer and bread wheats, attested in the archaeobotanical evidence, may also reflect this observation.¹⁸⁴ The macrobotanical analysis suggests that barley production was greater than that of wheat, and that it was more valuable locally as an “economic plant”; this is fairly consistent with macrobotanical studies of contemporary rural sites throughout Jordan that show that barley and wheat were cultivated in similar ratios.¹⁸⁵ It is not clear why this would be the case. Barley was generally a less expensive grain than wheat.¹⁸⁶ Urbanites believed wheat flour tasted better. Barley was fed to animals. Nonetheless, barley was valuable and marketable, not only locally but on the regional level. We regularly read of confiscations of barley (presumably for fodder for horses) during military campaigns, and Ibn Ḥijjī records the harvest of barley as often as he does that of wheat.¹⁸⁷ Payments in barley, and additional demands of sacks of barley, by landowners caused great hardship to peasants and led to conflict.¹⁸⁸ Confiscation of barley seems to have been more commonplace than that of wheat. Though wheat was arguably the preferred grain in Egypt,¹⁸⁹ this was not necessarily the case in Syria. We still do not fully understand food hierarchies, and the place different cereals occupied in the agrarian economies of different regions. Crop selection was conditioned by many factors, natural and cultural. The choice of sowing wheat or barley often depended on the timing and quality of the early rains. Early harvests of barley as a result of rains that arrived too late, moreover, resulted in insufficient quantities of the grain entering the markets too early, and high prices for bread resulted.¹⁹⁰

¹⁸⁴ See further discussion in the section *Land Use*.

¹⁸⁵ The macrobotanical samples point towards a slight dominance of 2-row hulled barley over primarily durum wheat and the rarer emmer and bread wheats combined. See the cited studies in this paper on Tall Abu Sarbut, Dhibān, and Khirbet Fāris. See also further discussion on Ghor as-Safi, Shuqayra al-Gharbiyya, and Bayda in Hansen, “The Agricultural Economy of Islamic Jordan.”

¹⁸⁶ Occasionally barley would reach the price of wheat, but this was exceptional (Ibn Ḥijjī, *Tārīkh*, 1:420).

¹⁸⁷ To cite two examples: *ibid.*, 2:606, 675.

¹⁸⁸ *Ibid.*, 2:759.

¹⁸⁹ Sato, *State and Rural Society*, 201.

¹⁹⁰ Ibn Ḥijjī, *Tārīkh*, 1:102.

Different cereals in most cultures had a different cultural connotation and economic appreciation. Most consistent is the preference for wheats and wheat-bread over barley and barley-bread. This preference usually resulted in a higher price for wheat, making it a relative luxury.¹⁹¹ Wheat and wheat-products also in the Mamluk period were seen as a luxury item compared to barley. Those who wanted to express modesty and piety through showing moderation in their dietary practices—such as various philosophical writers during the Mamluk period—therefore advocated eating “simple” products such as barley bread. Al-Ghuzūlī, a Berber contemporary of the Mamluks, made a classification of the wheat and barley breads consumed by various socioeconomic classes, and also stresses the consumption of barley by ascetics.¹⁹² This moral connotation of consuming modest cereals or foodstuffs in general, or refraining from consumption in general through fasting, is not limited to the Mamluk period, but was also practised by Christian monks and ascetics. In his *Maqāmāt*, al-Zamakhsharī (d. 1144) reproaches those who eat lavish food and moralistically argues that two loaves of barley bread are sufficient to sustain oneself.¹⁹³ In the fourteenth century, in a less favorable appraisal of barley’s status, al-Ghazzālī, in his *Book of Hope and Fear*, regales an anecdote of Jesus, who advises his disciples that living a pious life, which he expresses as “the eating of barley and sleeping on the middens with the dogs is a small price in the quest for Paradise.”¹⁹⁴

Long before that, for Roman authors, it was also fashionable to contrast the simple food-ways and simple ways in general of their mythic forbears with the “corruption” and opulence of their own day. In antiquity barley and millets, though sometimes viewed in a negative light or as a food for the poor, could also be presented in a positive light indicating that when prepared in a certain way, not even the “richer” classes could refuse them.¹⁹⁵ On the other hand, to be given barley instead of wheat was a punishment for military units that had underperformed or to the other nine-tenths of those who survived decimation.¹⁹⁶ Barley, and in particular barley-waters or gruels, were however also seen as a remedy for stomach and intestine-related maladies. Such references are found in Greek and Roman accounts. Al-Nuwayrī mentions these remedies as well a cure for scabs,

¹⁹¹ For a discussion, see Heinrich and van Pelt, “Graantransport en graanprijzen in Ramessidisch Egypte.”

¹⁹² Van Gelder, *Of Dishes and Discourse*, 99.

¹⁹³ *Ibid.*, 45.

¹⁹⁴ William McKane, *Al-Ghazali’s Book of Fear and Hope* (Leiden, 1965), 85.

¹⁹⁵ See M. S. Spurr, “The Cultivation of Millet in Roman Italy,” *Papers of the British School at Rome* 51 (1983): 1–15.

¹⁹⁶ G. R. Watson, *The Roman Soldier: Aspects of Greek and Roman Life* (Ithaca, 1969), 119.

wounds, and even gout.¹⁹⁷ In parts of the modern Islamic world the use of barley-waters for their (alleged) curative properties is still practiced.¹⁹⁸

Regardless of these cultural and moral appreciations, it is unlikely that these were a consideration that carried much weight for the Ḥisbān consumers and producer-consumers. To be able to restrict one's choice of staple crops is already a luxury. A rich man may choose not to eat wheat and eat barley instead with pious intentions, but the poor had to consume barley as it was cheapest. For small farmers, who also consumed part of their crop, the environmental (and other economic) considerations would have been the main determinant in selecting their crop. What role local and regional markets had to play in the decision-making process, and to what degree the *fallāḥin* were aware of the economic realities of these markets, remains a line of future research.

Economic factors, though, were at play in the cultivation and consumption of other crops. One economic plant, not documented by the archaeobotanical record but which nonetheless played a very important role at Ḥisbān, was sugar cane. Sugar cane was not grown on the Madaba Plains, but it was in the nearby Jordan Valley. Dozens of sugar molasses jars, which were used to store and transport the liquid molasses from sugar processing, were recovered in the excavations of the citadel storeroom in 1998 and 2001. The citadel clearly served as a storage place and redistribution point for a commodity that might have functioned as a side-business for the governor serving there.¹⁹⁹ This seemed to have served as the primary sweetener in the local diet, as the same jars have been recovered in subsequent excavation seasons from small storerooms attached to the farmhouses on the western slopes of the tell (Field C).²⁰⁰

For what markets, exactly, local wheat(s), barley(s), mutton, and sugar molasses were produced requires further study. Baybars al-Ẓāhiri's reference to the vil-

¹⁹⁷ Al-Nuwayrī, *The Ultimate Ambition in the Arts of Erudition*, 184.

¹⁹⁸ Personal comment (to Hansen), F. B. J. Heinrich on rural Sudan.

¹⁹⁹ On the molasses jars in the citadel storeroom, see Walker and LaBianca, "The Islamic *Qusur* of Tall Hisban"; Bethany J. Walker, "Mamluk Investment in Southern *Bilad al-Sham* in the Fourteenth Century: The Case of Hisban," *Journal of Near Eastern Studies* 62, no. 3 (2003): 241–61; and idem, "Sowing the Seeds of Rural Decline? Agriculture as an Economic Barometer for Late Mamluk Jordan," *Mamlūk Studies Review* 11, no. 1 (2007): 173–99. Citadels routinely provided storage spaces for agricultural goods, for both garrison consumption and to send on to other markets, as also served as temporary treasuries, during military campaigns and times of political turmoil.

²⁰⁰ For brief field reports on the storage of molasses in the farmhouses, Bethany J. Walker and Øystein S. LaBianca, "Tall Hisban, 2004: An Investigation in Medieval Rural History," *Newsletter of the American Center of Oriental Research* 16, no. 2 (2004): 1–3; idem, "Tall Hisban," *American Journal of Archaeology* 109, no. 3 (2005): 536–39; and idem, "Tall Hisban," pp. 516–18 in "Archaeology in Jordan, 2007 Season," ed. Stephen H. Savage, Donald R. Keller, and Christopher A. Tuttle, *American Journal of Archaeology* 112, no. 3 (2008): 509–28.

lage's control of 300 villages in the region gives us no details about the functional relationship, although it is arguably an economic one. What kinds of exchanges, through what mechanisms, operated in the movement of consumable goods from one village to the next is unknowable textually for Ḥisbān, though one can document it for the villages of the Damascus hinterland.²⁰¹ In the same vein, we do not know the nature of the local market (*sūq*), the merchants of which (*ahl al-sūq*) were moved to Amman by Amir Sarghatmish in the later fourteenth century, though one can assume agricultural goods, meat, and animal by-products were important components of it.²⁰² It may have functioned as an entrepôt for exchanges between Bedouin and village communities, as so many of the larger, interconnected regional markets did in Transjordan in the Mamluk period.²⁰³ Rural market structures can be partially reconstructed through late Mamluk- and Ottoman-era Syrian chronicles and travelers' accounts, and this will be a focus of our future research.

Economic Plants and the Business of Animal Husbandry

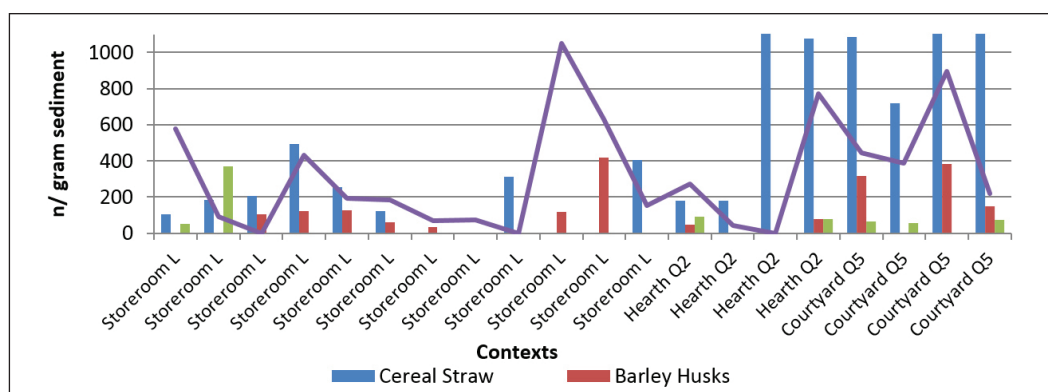
A Botanical Perspective: Phytoliths

It appears from the phytolith records derived from the citadel that local state officials depended on the storage and management of grains (Graphs 5a and b), but also on the production and management of cereal by-products such as straw (Graph 5a). These were valuable commodities that would sustain livestock for meat consumption at a subsistence level in the citadel, for the production of animal by-products and for the storage of animal dung used for fuel and manure. Phytolith evidence for animal dung used for fuel derived from the hearth context inside the governor's residence (Graph 5). Phytolith evidence for the storage of animal fodder and penning of livestock derived from the governor's courtyard (Field Q5) (Graph 5a). Wheat straw was of economic value for the inhabitants of Tall Ḥisbān village but was also a commodity which in the historic records is

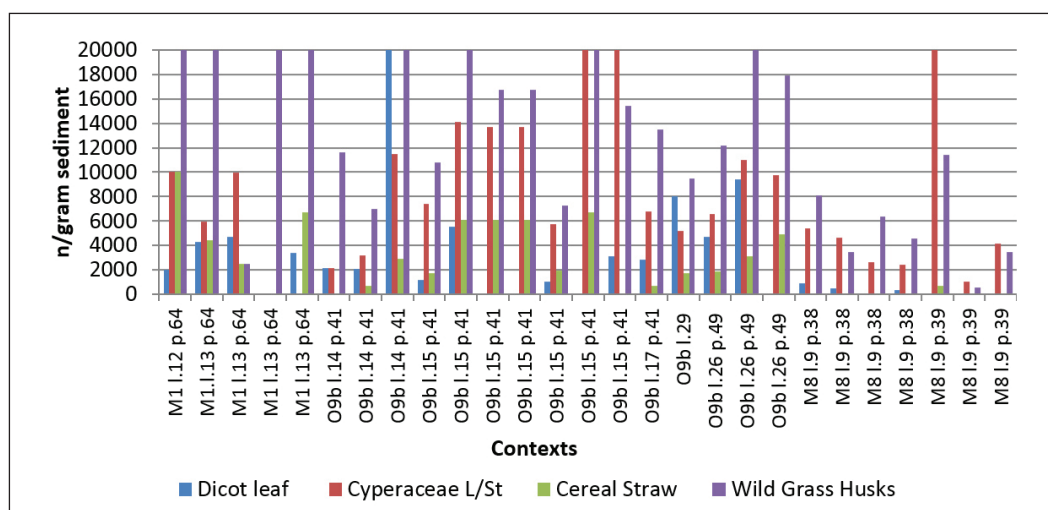
²⁰¹ For accounts of bread production in local village bakeries and mosques, *takīyah*, madrasah, and monastery kitchens, and the distribution of flour and bread between villages of the Ghūṭah, see Ibn Ṭūlūn, *Al-Qalā'id al-jawharīyah*, 1:53, 81, 82, 123, 166, and 267.

²⁰² Ibn Qāḍī Shuhbah, *Tārīkh*, 1:550.

²⁰³ S. S. M. Khalil, "Al-Tijārah al-Dakhiliyah fi Dawlat al-Mamālik al-Thaniyah (784–922 A.H./1382–1516 C.E.)" (Ph.D. diss., University of Jordan, 1992); Bethany J. Walker, "Regional Markets and their Impact on Agriculture in Mamluk and Ottoman Transjordan," in *On the Fringe of Society: Archaeological and Ethnoarchaeological Perspectives on Pastoral and Agricultural Societies*, ed. Benjamin Saidel and Evelyn van der Steen (Oxford, 2007), 117–25; Reem al-Shqour, "Aqaba Castle, origin, development and evolution of Khans in Jordan: An Archaeological Approach" (Ph.D. diss., University of Ghent, 2015).



Graph 5a. Cereal straw, barley, weed, and dicot leaf phytoliths.



Graph 5b. Dicot leaf, sedges, cereal straw, and wild grass husk phytoliths.

mentioned as being shared among the *dīwān*, *muqtaʿ*, and cultivators (*muzārīʿūn*) (see above).

However, phytolith results derived from the farmhouses (Squares O9, M8) demonstrated that peasants at Ḥisbān relied on livestock for animal dung and animal by-products, which had an important role in the household economy. The presence of crop-processing by-products, fodder, and/or dung, such as cereal husks, cereal straw, wild grass husks, and dicot leaf phytoliths, was shown in the phytolith records from the medieval farmhouse (Square O9) (Graph 2b). The phytolith record picked up the presence of dung that could possibly have been used as fertilizer. High densities of straw, wheat, barley, and weeds in the samples derived from the hearth could imply that animal dung may have been used

for fuel, as well.²⁰⁴ The phytolith evidence from the medieval village indicated the production and storage of agricultural by-products, such as cereal chaff and straw, and showed evidence for the exploitation of domestic livestock. Phytolith, macro-botanical, and zooarchaeological data derived from the site, of a variety of crops and animal species, suggest that a variety of crops were produced at Ḥisbān and that livestock played an important role in the local and state economy. The environmental data indicated that a diversified, and arguably sustainable, agricultural economy was practiced on the state and village-level.

A Botanical Perspective: Seeds and More

Demographic data, which is highly important for understanding a local agricultural economy, is limited at best for rural southern Bilād al-Shām in the Mamluk period. For instance, there are no Mamluk-era census reports or tax records for the area.²⁰⁵ Some indication of demography follows from the settlement's size: not including the agricultural land, the Mamluk-era settlement is about six hectares, but the town/village likely extended well beyond that.²⁰⁶ This lack of demographic data makes an understanding of the agricultural (and animal husbandry) productivity²⁰⁷ an even more significant economic proxy.

Some historical sources contain information on villages in southern Bilād as-Shām, in which taxes are exacted by the state or local authority. For example, we

²⁰⁴ Michael Charles, "Fodder from dung: the recognition and interpretation of dung derived plant material from archaeological sites," *Environmental Archaeology* 1 (1996): 111–22; Georgia Tsartsidou, Simcha Lev-Yadun, Rosa-Maria Albert, Arlene Miller-Rosen, Nikos Efstratiou, and Steve Weiner, "The phytolith archaeological record: strengths and weaknesses evaluated based on a quantitative modern reference collection from Greece," *Journal of Archaeological Science* 34 (2007): 1262–75; Marijke Van de Veen, "The economic value of chaff and straw in arid and temperate zones," *Vegetation History and Archaeobotany* 8 (1999): 211–24. The macro-botanical samples at Tall Ḥisbān also attested charred dung; see Hansen (macrobotanical sections), this article.

²⁰⁵ Walker, *Jordan in the Late Middle Ages*, 136.

²⁰⁶ *Ibid.*, 149. To date seven village houses have been excavated. The surface of the tell slopes and base, however, are covered by the undulating patterns of wall stubs and collapsed vaults. It is not possible, at this time, to estimate the number of extant structures within the Department of Antiquities fence.

²⁰⁷ Agricultural productivity is defined as the ratio of agricultural outputs to agricultural inputs. Agricultural inputs include labor, land yield (also increased yield per plant), agricultural tools/implements, fertilizers (e.g., manure and manuring practices), irrigation, "pesticides" such as urine to discourage predation (also from unwanted grazers), animal fodder efficiently processed for better digestion, keeping animals indoors in cold weather, and maintaining good health of beasts of burden for maximum work efficiency and of other animals for high meat quality. Agricultural outputs are measured by the market value of the final output (products produced); they can include the crop yield and its market value (based on supply/demand, and market manipulation).

know from historical records that a percentage of the grain crop (or tax-in-kind) was collected and stored in state storage facilities (*shunahs*), and grains for household consumption were likely stored in repurposed caves and defunct cisterns, though the archaeological record has yet to be fully studied.²⁰⁸ Beyond this, bioarchaeological data helps provide a more complete picture of the village economy of Mamluk Tall Ḥisbān within the site and between other sites. The rich deposits of bioarchaeological material, such as food waste and cereal-processing waste, attest to the farming and animal husbandry at and around the site. Ceramic (local and foreign), metal and flint (from farming implements and medical tools), and glass evidence attest to the participation of the villagers in local industries and also in regional trade. While clay ovens for bread-baking and other cooking wares were produced locally, sugar jars indicate the import of processed sugar in the form of a molasses from the Jordan Valley, and parrot fish bones indicate the import of parrot fish from the Red Sea region.²⁰⁹ All of this attests to their participation in a wider market economy.

This may be in contrast with previous periods at Tall Ḥisbān and throughout Jordan, mainly during the Iron Age, when it was not uncommon for groups of agro-pastoralists to occupy a settlement only for the duration of the harvest, corresponding to a less developed economy. Such seasonal settlement seems also to have occurred later in the Tanzimat Ottoman period at and around Tall Ḥisbān.²¹⁰

Activities such as the construction of a bread oven,²¹¹ involving resource management and specialized labor, can help one understand the microeconomics of a village site, while understanding the crop regime and animal husbandry²¹² helps one understand their macroeconomics as well, mainly through their participation in regional (within Bilād al-Shām) and “imperial” (within the Mamluk empire) markets and trade.²¹³ Therefore, the archaeobotanical record reflects the region’s (al-Balqa’s) reputation as the “bread basket of Jordan.” Because of the wide range of cereals produced at the site, this indicates that farmers could spread risk over multiple cereal crops. Barley and durum wheat are more adaptable to drier

²⁰⁸ See historical discussion above.

²⁰⁹ See zooarchaeological report below.

²¹⁰ Walker, *Jordan in the Late Middle Ages*, 216–17.

²¹¹ Hansen, Walker, and Heinrich, “‘Impressions’ of the Mamluk Agricultural Economy.”

²¹² See Corbino (zooarchaeology sections), this article.

²¹³ In 1336 Sultan al-Nāṣir Muḥammad ordered the surplus grains from Karak, Shobak, Damascus, and Gaza to be shipped to Cairo during a grain shortage (Walker, *Jordan in the Late Middle Ages*, 87, from Adam Sabra, *Poverty and Charity in Medieval Islam: Mamluk Egypt 1250–1517* [Cambridge, 2000], 144, citing al-Yūsufi and al-Maqrīzī). The extent to which this fairly dramatic event would have affected the local economy of Tall Ḥisbān, and if the Ḥisbānī community would have been called upon to help resupply these regional centers or even contribute to the “global effort,” is not clear at this point.

environments than bread and emmer wheat, while barley is also adaptable to saline soils. Although durum wheat can produce high yields, hulled barley and emmer wheat store more securely, as the presence of their husks protects the grain kernels from pests.²¹⁴

The high proportion of barley to hard wheat is also interesting and could mean different things. While barley is suited to drier, more saline environments, it does not necessarily mean that the preference for cultivating barley over hard wheat is (only) due to environmental stimuli. In fact, when irrigation is practiced, soil salinity increases (efficient drainage or washing out by river floods like in Egypt may negate this effect). In addition, barley does not require much manure to produce a good yield. Manure was a valuable resource for fuel in villages in this period. Therefore, the higher cultivation of barley would potentially allow the higher distribution of this resource for fuel. The cultivation of barley could also mean that this is a deliberate strategy to maintain a reliable production yield to produce enough to meet the tax-in-kind, which could have been paid as a percentage of all cereals produced, as well as to feed the community. These factors could be an “indicator” or “response” to population pressure from a growing population in this period.²¹⁵

A Zooarchaeological Perspective

Sheep/goats in the Tall Ḥisbān sample were primarily exploited for meat production. Forty-five percent of sheep/goats from the citadel were slaughtered when they were really young, less than six months old. The practice of killing juveniles could also be related to the production of milk and dairy products; however, so far no other evidence supports this hypothesis. The few adult and senile sheep/goats identified in both areas attest that some individuals were kept longer for breeding purposes, as well as for wool production. The faunal remains from Dhibān, a Mamluk village located a few kilometers south of Ḥisbān, confirm that the production of milk and wool was not of primary importance in the Middle Islamic period.²¹⁶ Milk and wool trade may have not been relevant in the economic system of this area of the Mamluk Empire. The demand for these two products was probably satisfied by small-scale or household production.

In the Mamluk period, goat husbandry spread in Jordan.²¹⁷ This species is more adaptable to semi-arid environments and a climatic change in this direction may

²¹⁴ Heinrich, “Modelling Crop-Selection in Roman Italy.”

²¹⁵ Cf. Robert Sallares, *The Ecology of the Ancient Greek World* (Ithaca, 1991).

²¹⁶ Sara W. Kansa, “Fauna evidence from Middle Islamic Dhibān: interim report on the 2005 season,” in “Digging Deeper,” 256–59.

²¹⁷ Robin Brown and Kevin Reilly, “Faunal remains from Mamluk and Ottoman Occupations in the Middle Islamic Period Palace at Karak Castle (Qal’at al-Karak),” in *The Archaeology of Agro-*

have caused a change in its frequency. In sheep/goats, the prevalence of pathological evidence on juveniles from the citadel associated to arthritic deformations (not related to senescence) in the Ḥisbān assemblages could be related to intensive breeding and poor grazing in semi-arid environments. These animals were bred for local elite consumption, and probably also for trading in the region. Large flocks were likely kept in the site's surroundings, exploiting the nearby caves as natural shelters. The intensification of agricultural activities in the Mamluk period²¹⁸ probably reduced the available pastures. In this case, the animals would have needed to cover greater distances in search of food, crossing rough terrains, which contributed to the occurrence of arthritic deformations. For this reason, the diet of domestic animals at Tall Ḥisbān was probably supplemented with fodder crops, pulses, and cereal processing by-products. One such fodder crop, alfalfa, has been identified among the archaeobotanical remains recovered at the site.²¹⁹

Parrotfish remains collected from both the citadel and medieval village at Tall Ḥisbān suggest economic links with the Red Sea region. Whole fish, not only fillets, were acquired, as confirmed by the presence of all anatomical parts of the skeleton. It was traded as a dried, smoked, or salted product. The occurrence of parrotfish remains in the Petra valley proves that it was a common source of food in settlements from the Early Roman to the Mamluk period.²²⁰ The high incidence of this fish in medieval contexts is suggestive of trade routes that moved northwards from Aqaba along the King's Highway. Distribution and consumption of fish in the Petra Valley was favored by the relatively close distance of the region from the Red Sea. Indeed, more distant settlements, such as Karak, Dhibān, and Ḥisbān, show lower proportions of fish.²²¹ In addition, the abundance of fish remains was probably also related to the abstinence from meat on specific days of the Christian calendar.²²² In the late thirteenth century, dried fish from the Red Sea was obtained by Christian merchants from Karak and Shawbak in exchange for raisins, olives, and olive oil.²²³ Although the drastic reduction of this taxon in

pastoralist Economies in Jordan, ed. McGeough, 91–134.

²¹⁸ See Laparidou, in this article.

²¹⁹ See Hansen, in this article.

²²⁰ Stephan G. Schmid and Jacqueline Studer, "Products from the Red Sea at Petra in the medieval period," in *Natural Resources and Cultural Connections of the Red Sea*, ed. J. Starkey, P. Starkey, and T. Wilkinson, British Archaeological Reports International Series 1661 (Oxford, 2007), 45–56.

²²¹ Brown and Reilly, "Faunal remains."

²²² Ibid.

²²³ Muḥammad 'Adnān al-Bakhīt, *Das Königreich von al-Karak in der mamlūkischen Zeit*, trans. A. Scheidt (Frankfurt, 1992), 35.

the archaeological assemblages of the Mamluk period needs further investigation, current data suggest that it gradually disappeared from the diet.²²⁴

The frequencies and variety of wild species in the citadel assemblage confirm that hunting activities and game meat were a prerogative of the Mamluks. Some of the wild taxa identified in the citadel sample may have been directly hunted by the residents of the garrison. The natural habitats of roe and fallow deer could be found some kilometers from Ḥisbān; this raises the question of how the carcasses of these animals reached the site. Hunting in this manner required covering long distances. However, it is also possible that this game meat reached the site through trade with local pastoral communities.²²⁵ The few remains of gazelle and ibex collected from the village indicate that the farming population also occasionally engaged in hunting activities, as hypothesized by Brown.²²⁶

A further economic indicator in the analyzed assemblages is the evidence for animal ravaging (Fig. 3). High frequencies of bites in the citadel sample are probably linked to the presence of dogs. Indeed, dog bone remains have only been recovered from the citadel. They were likely involved in hunting activities. In the village, evidence of bites is considerably lower and dog remains are not present. Therefore, in this specific case the presence of dogs could be considered a further indicator of social status. Although it is a useful animal, not everyone could have afforded keeping a dog.

Differences in status between the citadel and the village at Ḥisbān, highlighted by the study of animal bones, suggest the existence of two different food production systems. The meat diet of the garrison was based on large-scale production and wild game, while the villagers relied mainly on small-scale husbandry. In this perspective, variations in the exploitation of animal resources at the site could highlight differences in the garrison's and villagers' relationship with the local environment.

Concluding Thoughts: Ethics of Land Use vs. a Moral Economy

We return, in conclusion, to the main theme of the article: the effectiveness and impact of Mamluk management of agricultural resources. Did the Mamluk state ("body politic") have an "environmental sense?" Did it behave ethically in this regard? What concerns ultimately drove decisions about land use (cropping), and who made those decisions?

²²⁴ Brown and Reilly, "Faunal remains."

²²⁵ See historical discussion above.

²²⁶ Brown, "The faunal distribution from the Southern Highlands of Transjordan."

The term “moral economy” was originally devised by Harvard Professor Ralph Barton Perry in 1909, to study the importance and function of morality within society and in governance, both on the individual and community level. His thesis, which would be taken up by scholars in other fields, was based on the concept of reciprocity. He argued individuals and communities were responsible for upholding the practice of reciprocity, both for themselves and society at large, and carefully managed everyday exchange through the concepts of prudence, moderation, and veracity. In his view, this was the “best” means of achieving and maintaining balance in the individual and interdependence within society as a whole.²²⁷

Perry’s concept was picked up and developed further in social science and anthropology by scholars like James C. Scott. Scott adopted the concept to better understand how peasant economies distribute resources in the presence of scarcity. Scott focused specifically on how peasant society is affected by land tenancy and taxation through case studies in Burma and Vietnam, and his work offers a helpful analogy for their social structure and also how these groups perceive reciprocity and their determination to acquire it through social justice. In his case studies, Scott observes social and economic behaviors that have been adapted in the work of (ethno-) archaeologists, such as Paul Halstead and John O’Shea and especially H. Forbes, whose fieldwork centered on Greek farmers in the 1960s.²²⁸ Scott summarizes these typical behaviors as the following:

[m]any of the seeming anomalies of peasant economies arise from the fact that the struggle for a subsistence minimum is carried out in the context of a shortage of land, capital, and outside employment opportunities. This restricted context has at times driven peasants...to choices that defy standard bookkeeping measures of profitability. Peasant families which must feed themselves from small plots in overpopulated regions will (if there are no alternatives) work unimaginably hard and long for the smallest increments in production....Because labor is often the only factor of production the peasant possesses in relative abundance, he may have to move into labor-absorbing activities with extremely low returns until subsistence demands are met. This may mean switching crops or techniques of cultivation (for example, switching from broadcasting to transplanting rice) or filling the slack agricultural season with petty crafts, trades, or marketing which return very little

²²⁷ Ralph Barton Perry, *The Moral Economy* (Cambridge, 1909), 87–88.

²²⁸ *Bad Year Economics: Cultural Responses to Risk and Uncertainty*, ed. Paul Halstead and John O’Shea (Cambridge, 1989). H. Forbes, “Of grandfathers and grand theories: the hierarchized ordering of responses to hazard in a Greek rural community,” in *ibid.*, 87–97.

but are virtually the only outlets for surplus labor....The overriding importance of meeting family subsistence demands frequently obliges peasants not only to sell for whatever return they can get but also to pay more to buy or rent land than capitalist investment criteria would indicate. A land-poor peasant with a large family and few labor outlets is often willing to pay huge prices for land... so long as the additional land will add *something* to the family larder. In fact, the less land a family has, the *more* it will be willing to pay for an additional piece: a competitive process that may drive out capitalist agriculture which cannot compete on such terms... The continued application of labor to poorly compensated farming or handicrafts...is a product of the low opportunity cost of labor for the peasant (that is, few outside employment possibilities) and the high marginal utility of income for those near the subsistence level. It makes sense, in this context, for the peasant to continue to apply labor until its marginal product is quite low—perhaps even zero.²²⁹

Scholarship on the Mamluk “moral economy,” on the other hand, has tended to focus on the shared expectations of the government by the urban poor, which were grounded in a common sense of fairness and justice.²³⁰ The biggest issues in this regard relate to speculation on wheat prices, hoarding of cereals, and forced purchases of cereals at artificially high prices (*tarḥ*) during times of famine.²³¹ Contemporaries were quick to identify the sources of their suffering: the avarice attributed to corrupt amirs, grain brokers, and *waqf* administrators, the officials with whom rural peoples had direct contact and who collected taxes. Illegal diversions of water (and monopolization of irrigation canals) were not only flashpoints of dissent within communities but also constituted some of the most heated conflicts between villagers and amirs.²³² There were more localized conflicts, as well, that reveal expectations of local communities of ethical practice in production and distribution of food. The mixing of cereals in bread and marketing them as

²²⁹ James C. Scott, *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia* (New Haven, 1976), 13–14. See also Alexander V. Chayanov, *The Theory of Peasant Economy* (Homewood, 1966) for theoretical background on this topic.

²³⁰ The opposition of the ulama to the sultans’ confiscation of endowments (that brought them considerable financial gain by the late Mamluk period) will not be dealt with here.

²³¹ Boaz Shoshan, “Grain Riots and the ‘Moral Economy’: Cairo, 1350–1517,” *Journal of Interdisciplinary History* 10, no. 3 (1980): 459–78; Amalia Levanoni, “The al-Nashw Episode: A Case Study of ‘Moral Economy,’” *Mamlūk Studies Review* 9, no. 1 (2005): 207–20.

²³² Shoshan, “Mini-Dramas by the Water”; Walker, *Jordan in the Late Middle Ages*, 207–11.

“pure,” for example, is regularly addressed in *ḥisbah* manuals.²³³ These conflicts center, then, on distribution of food and water. Governmental interference in land use—what to sow and how to sow it—is never an issue.

“Environmental sense” is the connection (or disconnection) between knowledge about “best agricultural practices” (in terms of sustainability, not profit) and its application. In this way, one needs to differentiate between the “state” as policy-maker, and individuals as either government officials or private entrepreneurs. The privatization of land from the mid-fourteenth century is a pivotal factor in transforming these relationships. The Mamluk state, as a political body, did not play a direct or active role in agrarian matters, outside of the sugar industry.²³⁴ Its main concern, as always, was effective tax assessment and collection. Private land owners, on the other hand, were excellent pragmatists, and this is where one can identify careful thought to crop selection, knowledge of agricultural markets, and what we would call today an eye to sustainability. Officials who became private land owners, and scholars who were named as *waqf* administrators, relied heavily on local know-how, and many were careful custodians of the land, in an effort to develop their estates and make them profitable on the long-term. The case of Tall Ḥisbān illustrates the intersection between two forces: evolving state priorities and time-tested local practice. Intensified grain production in the fourteenth century was a governmental priority but one executed by local hands using local knowledge. One reads of no direct conflicts between Ḥisbānīs and officials over this matter or any other one related to local agriculture, tax collection, or water use. The inability of the Mamluk regime to sustain grain cultivation on this scale, in this manner, over the long run, which is suggested by the abandonment of grain fields across the Transjordan in the fifteenth century, does not appear to have been the result of poor land management, but of economic and climatic factors that were beyond the control of local officials.

²³³ To cite one example, Muḥammad ibn Muḥammad ibn Aḥmad al-Qurshī “Ibn al-Ukhūwah” (d. 729/1329), *Maʿālim al-Qurbah fī Aḥkām al-Ḥisbah*, ed. Robin Lowry (Cambridge, 1937).

²³⁴ This topic is beyond the focus of this paper, as there was no cultivation of sugar cane at Tall Ḥisbān. One should note, however, that sugar cultivation, which was generally under the control of the Mamluk government and high ranking officials, disrupted traditional water sharing arrangements, planting schedules, and organization of labor. For more on this topic, see Sato, *State and Rural Society*, 213ff; Walker, *Jordan in the Late Middle Ages*, 207–8.